

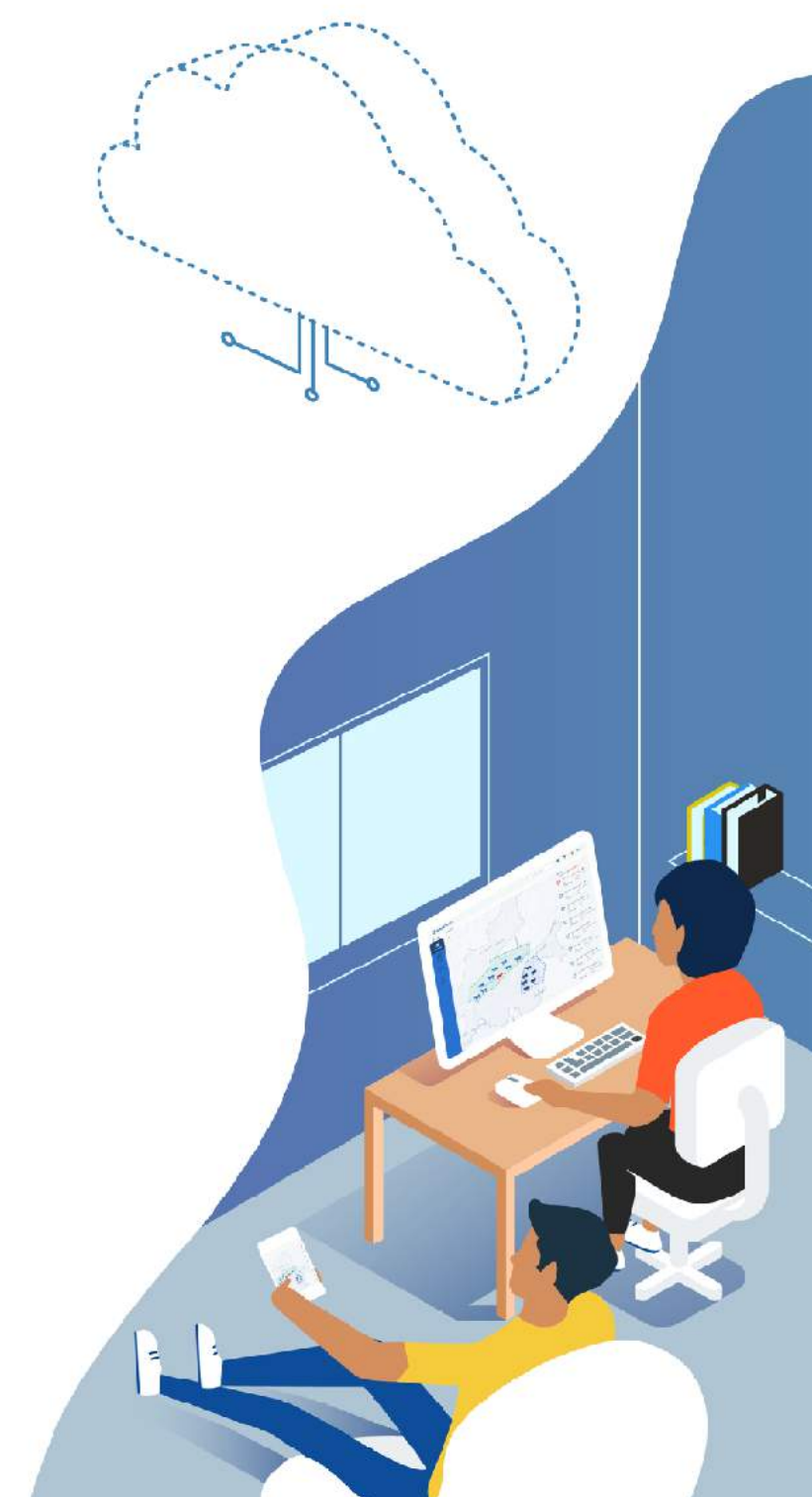


AI & IoT-powered Precision Livestock Farming



Andri Yadi
CEO, DycodeX

CBC-ILA - Jun 16, 2020





About Me



Andri Yadi

Co-founder & CEO of DycodeX

Vice Chairman, Indonesia IoT Association (ASIOTI)

Microsoft MVP, Azure

[a \(at\) dycodex.com](mailto:a(at)dycodex.com) | andriyadi.com | github.com/andriyadi

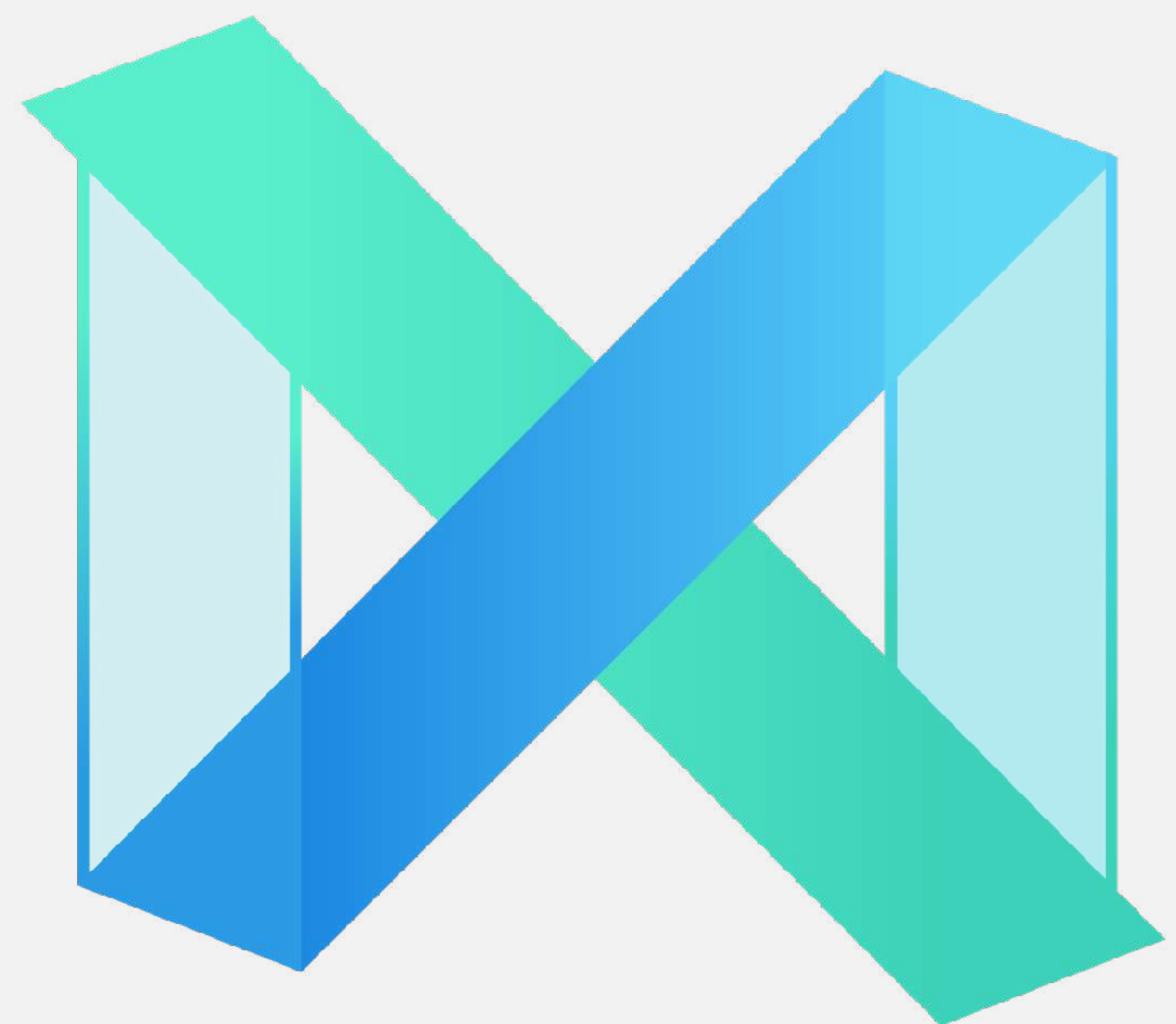
Physicist, Developer, Maker, Community Guy, Entrepreneur

Microsoft Most Valuable Professional (MVP) for 12 years

Code for food & passion for 20 years

Break & make electronic stuffs for 22 years

Trying to change the world through entrepreneurship, 15 years now



DYCODEX

PT. DycodeX Teknologi Nusantara

My Company

Our vision is to solve big problems with technology.

We're 5 years tech startup, pioneering and leading in developing end-to-end in-house **Artificial Intelligence (AI)** & **Internet of Things (IoT)**-powered products & solutions in Indonesia.

As seen on

YAHOO!
NEWS

Google

DailySocial^{id}

e27

INFOKOMPUTER

TECHINASIA

CNN
Indonesia

METRO TV

Bloomberg
TV INDONESIA

BERITA SATU

Pikiran Rakyat

SWA

LIPUTAN 3

VIVA.co.id
#1 newstainment

Approach

We approach our solutions to be powered by **AI + IoT**, end to end



Combining **AI + IoT (AIoT)** enables a lot of opportunities!

In 11 years

8.5 Billion
Human in planet Earth

Production needed

1.2 Billion
Tons of milk

400 Million
Tons of meat*

From
1.8 Billion
Cattle*



Food & Agriculture
Organization

“Livestock sector is one of the **fastest growing** parts of the agricultural economy, contributing **40%** of the global value of agricultural output and support the food security of **1.3 billion people**”

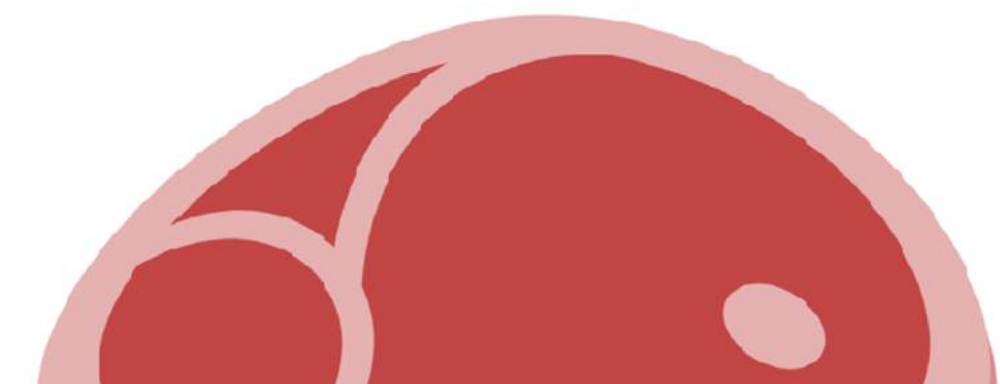
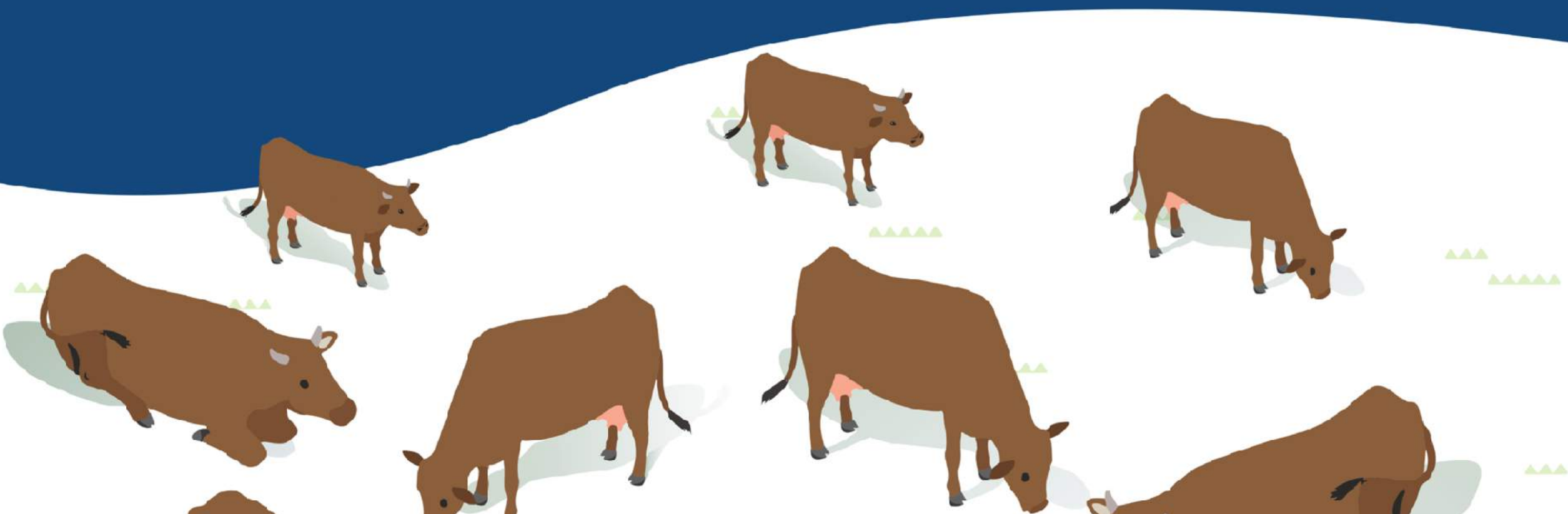
”

“Indonesia will be self-sufficient in beef in the next **10 years**”

”



Ir. Joko Widodo,
President of Indonesia



*FAO

Program Strategis Kementan

Mempercepat peningkatan populasi sapi di tingkat peternak

Memperkuat aspek pembenihan dan pembibitan

Penambahan indukan impor

Pengembangan Hijauan Pakan Ternak

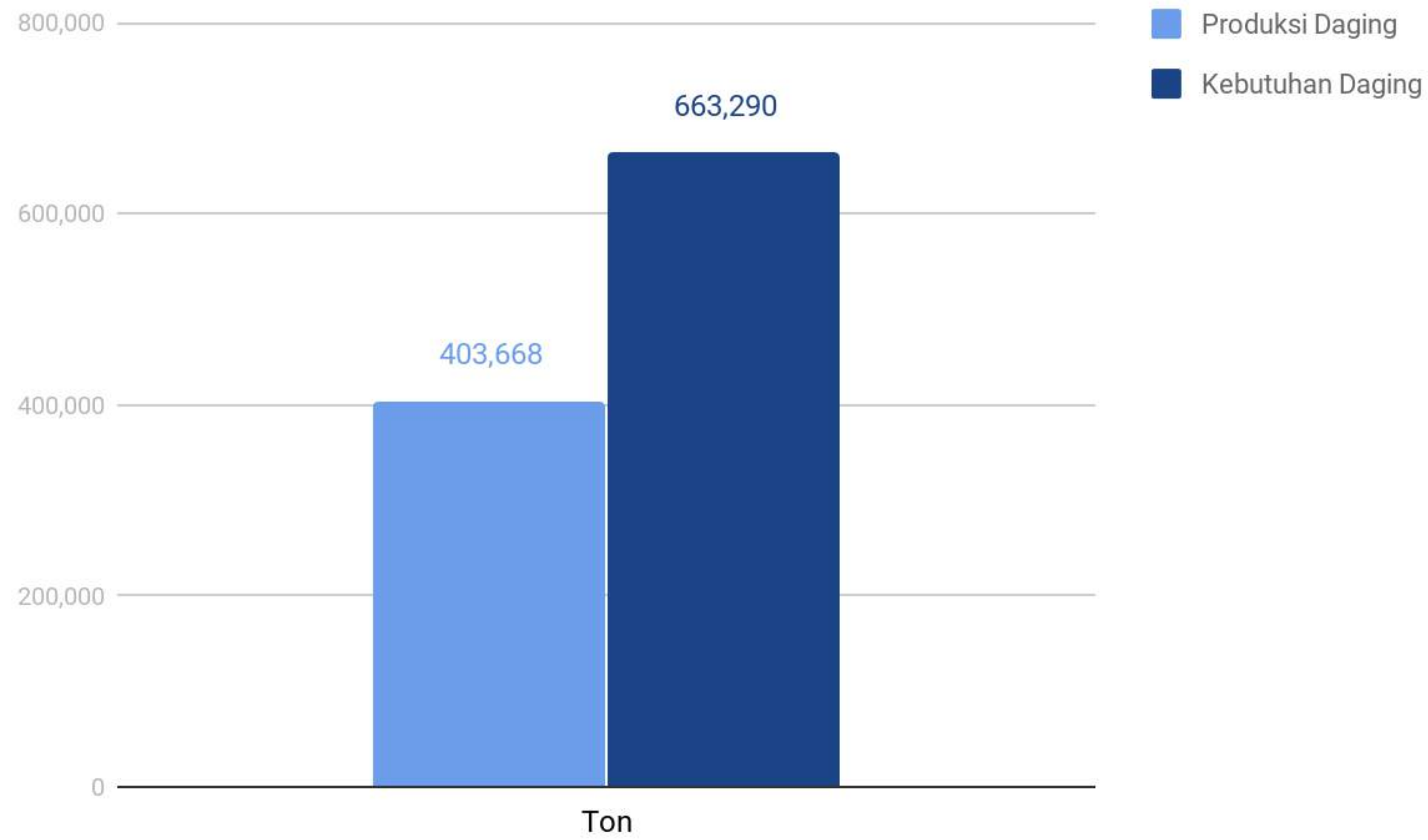
Penanganan gangguan reproduksi

Penyelamatan sapi betina produktif

Penanggulangan dan pemberantasan penyakit hewan

Our Challenges...

Indonesia's beef supply is still less than 60% out of demands



Source: "259.662 Ton Kebutuhan Daging Dipenuhi dari Impor". CNBC Indonesia. Diakses 27 Februari 2019.





Cattle farming still has real world problems

“We have no reliable way to track **feeding behaviour**. Non-eating cows are often found dead after 2-3 days.”

A personal farm, Subang - Indonesia
Manages 400+ cows

HERD COUNTING

“We often lose count when a herd of cows moves between grazing areas”

A corporate farm, Indonesia, manages 8000+ cows

OPERATION EFFICIENCY

“We have to visit hundreds of cows every day, just to check if they still move. Active cows are the best breed”

Cattle Breeding Centre - Ministry of Agriculture
Manages 1400+ cows

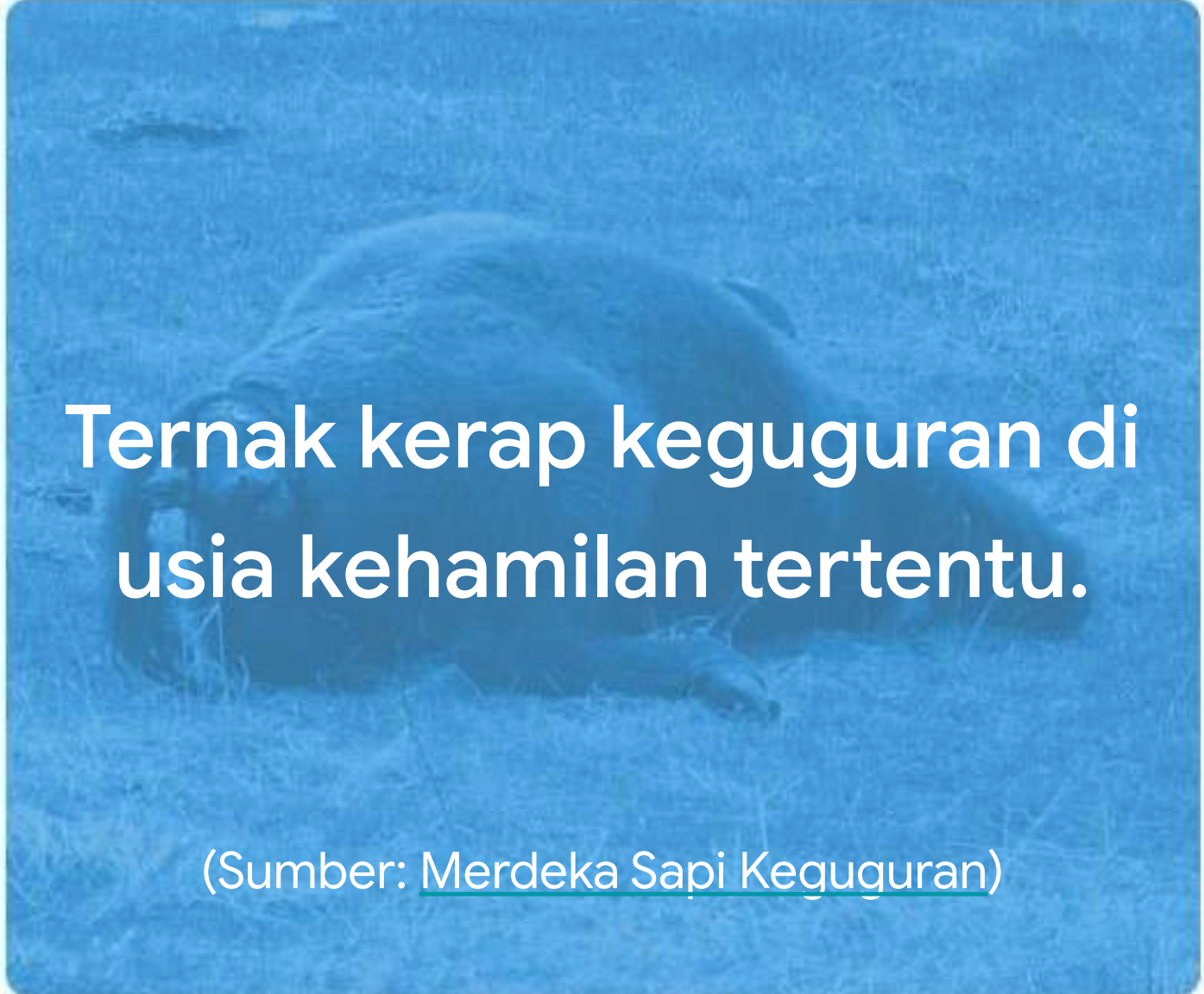
FOOD SECURITY & TECH

“We have no reliable data to answer a simple question, can we feed the nation?”

“The best monitoring **technology** we’ve deployed is RFID-based ear tag”

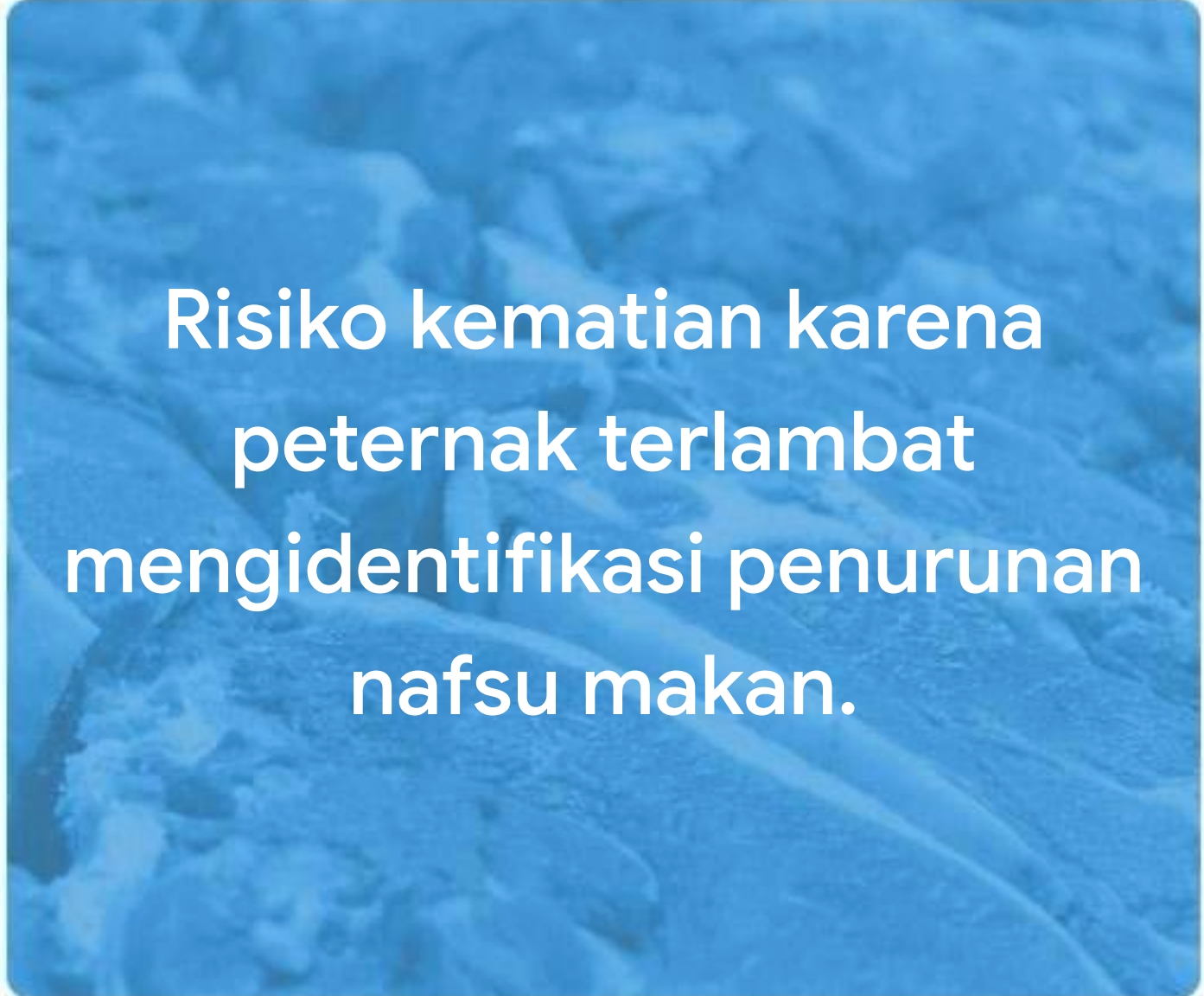
Ministry of Agriculture, Indonesia

Other Problems

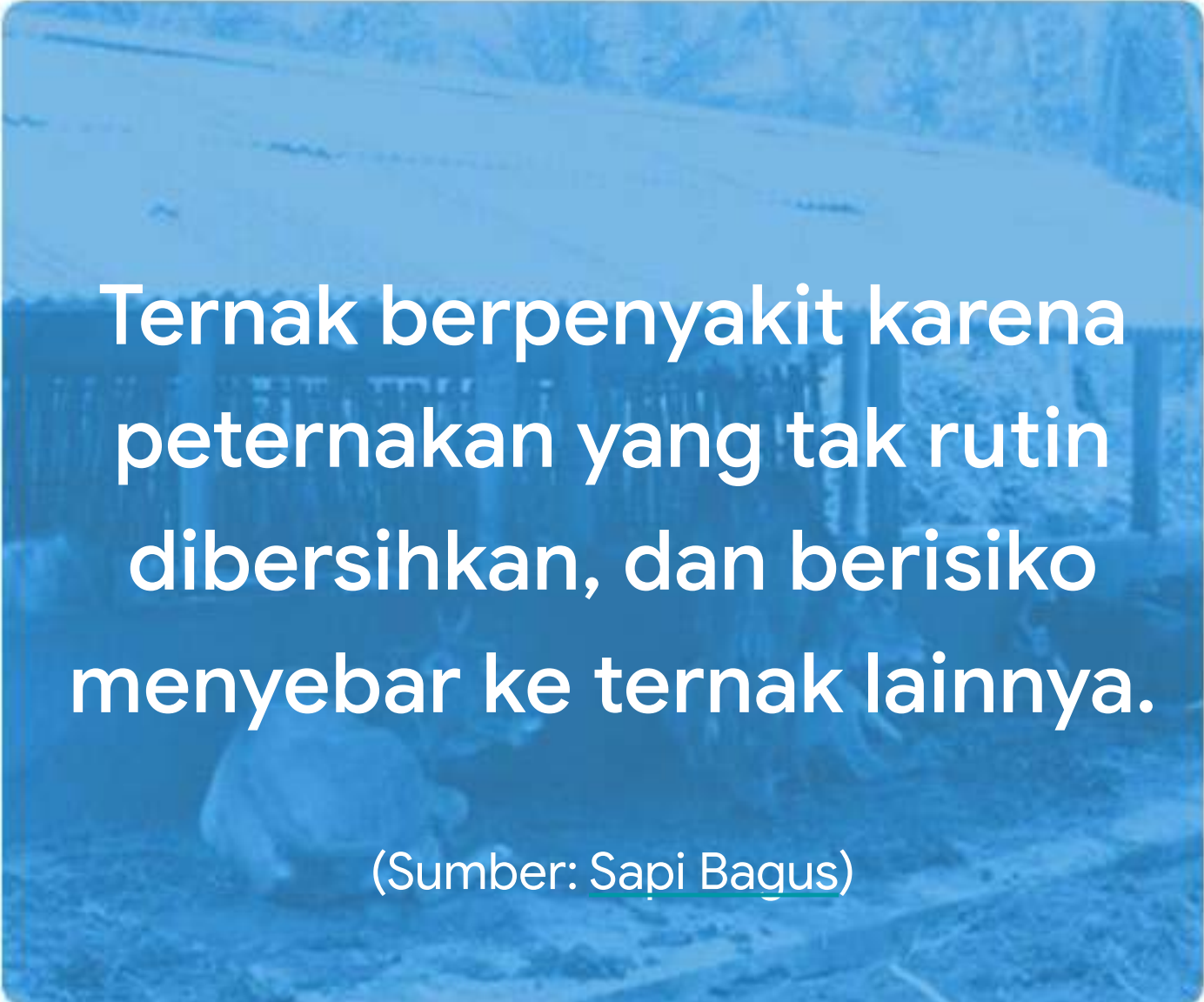


Ternak kerap keguguran di usia kehamilan tertentu.

(Sumber: Merdeka Sapi Keguguran)

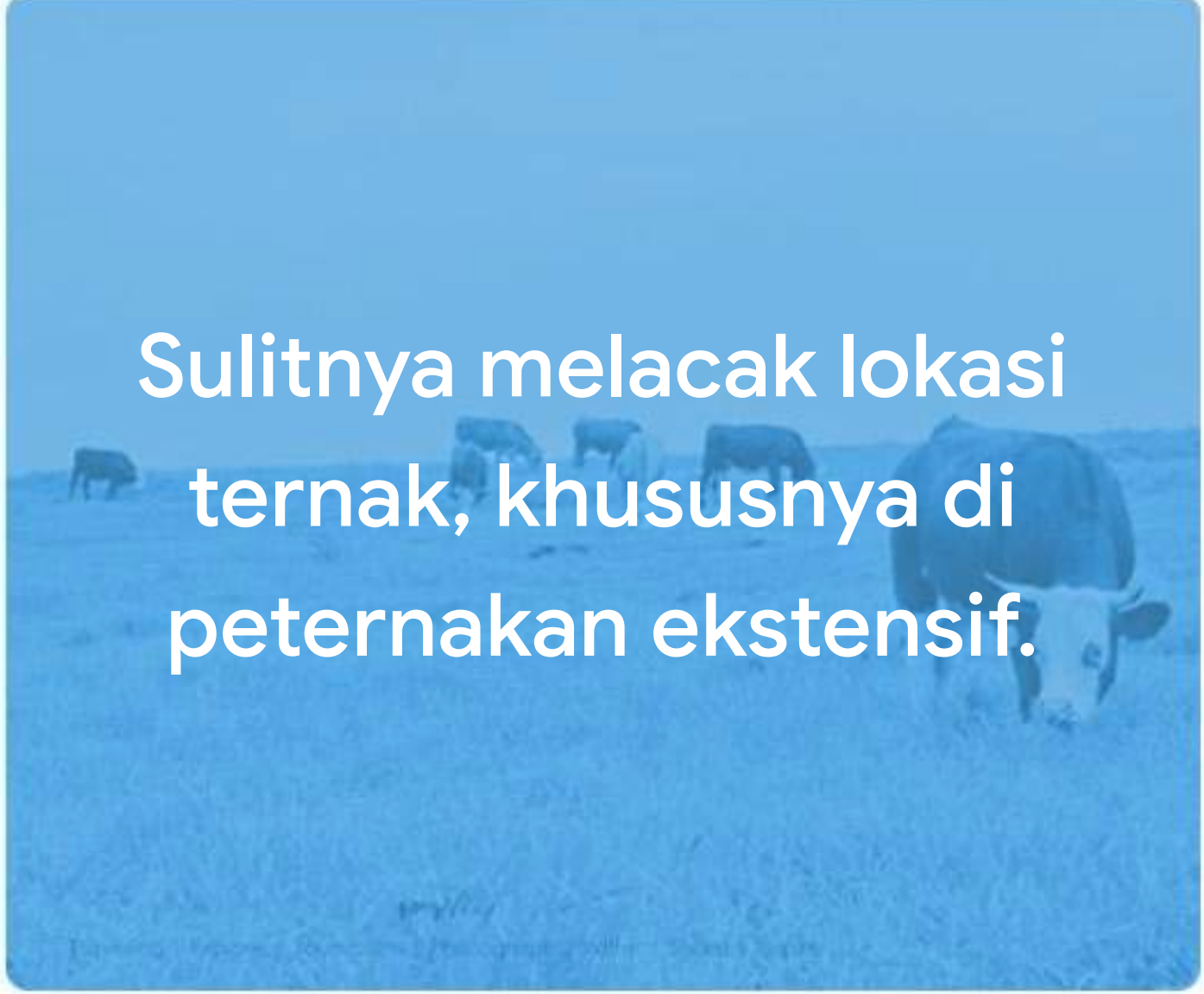


Risiko kematian karena peternak terlambat mengidentifikasi penurunan nafsu makan.

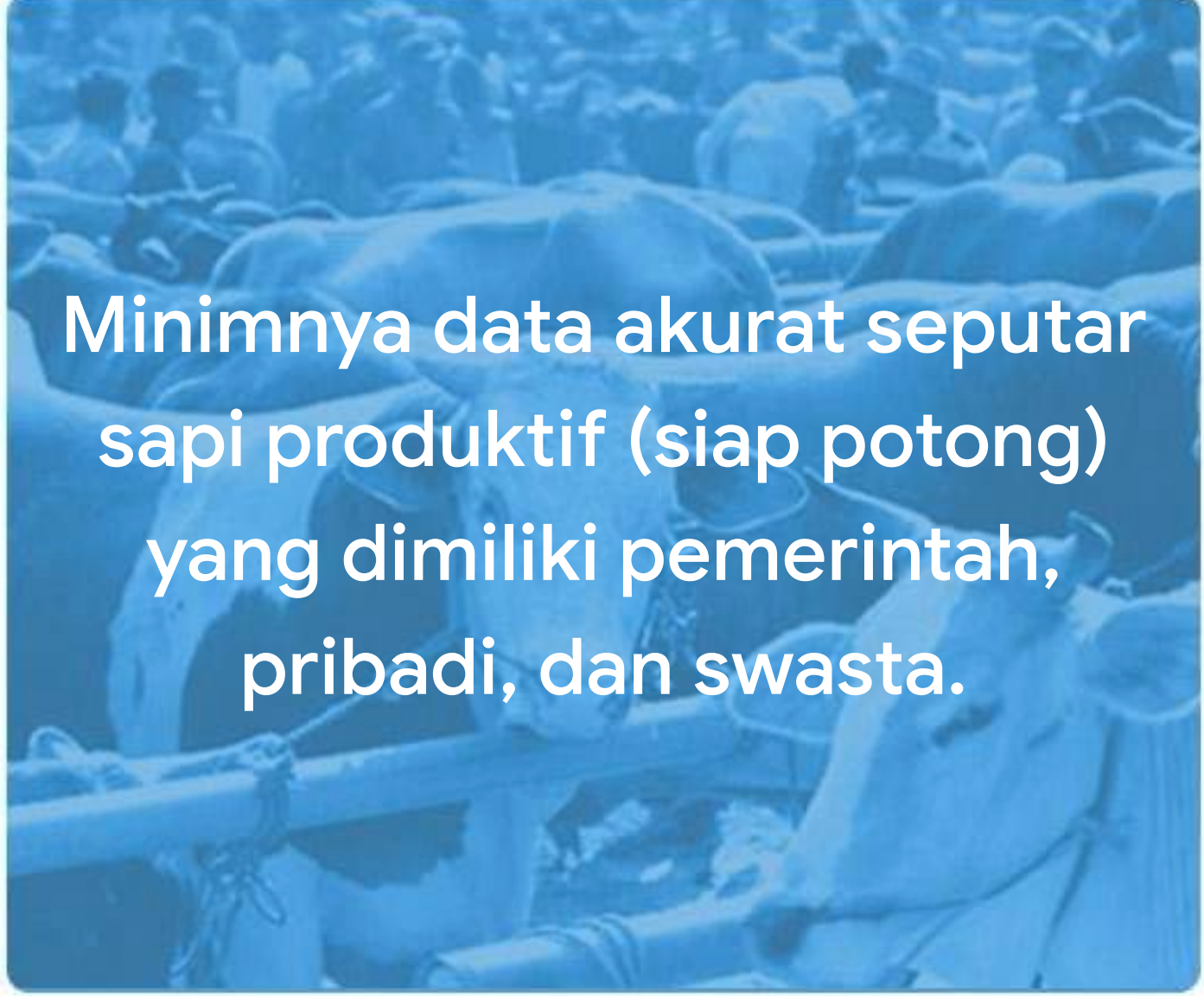


Ternak berpenyakit karena peternakan yang tak rutin dibersihkan, dan berisiko menyebar ke ternak lainnya.

(Sumber: Sapi Bagus)



Sulitnya melacak lokasi ternak, khususnya di peternakan ekstensif.

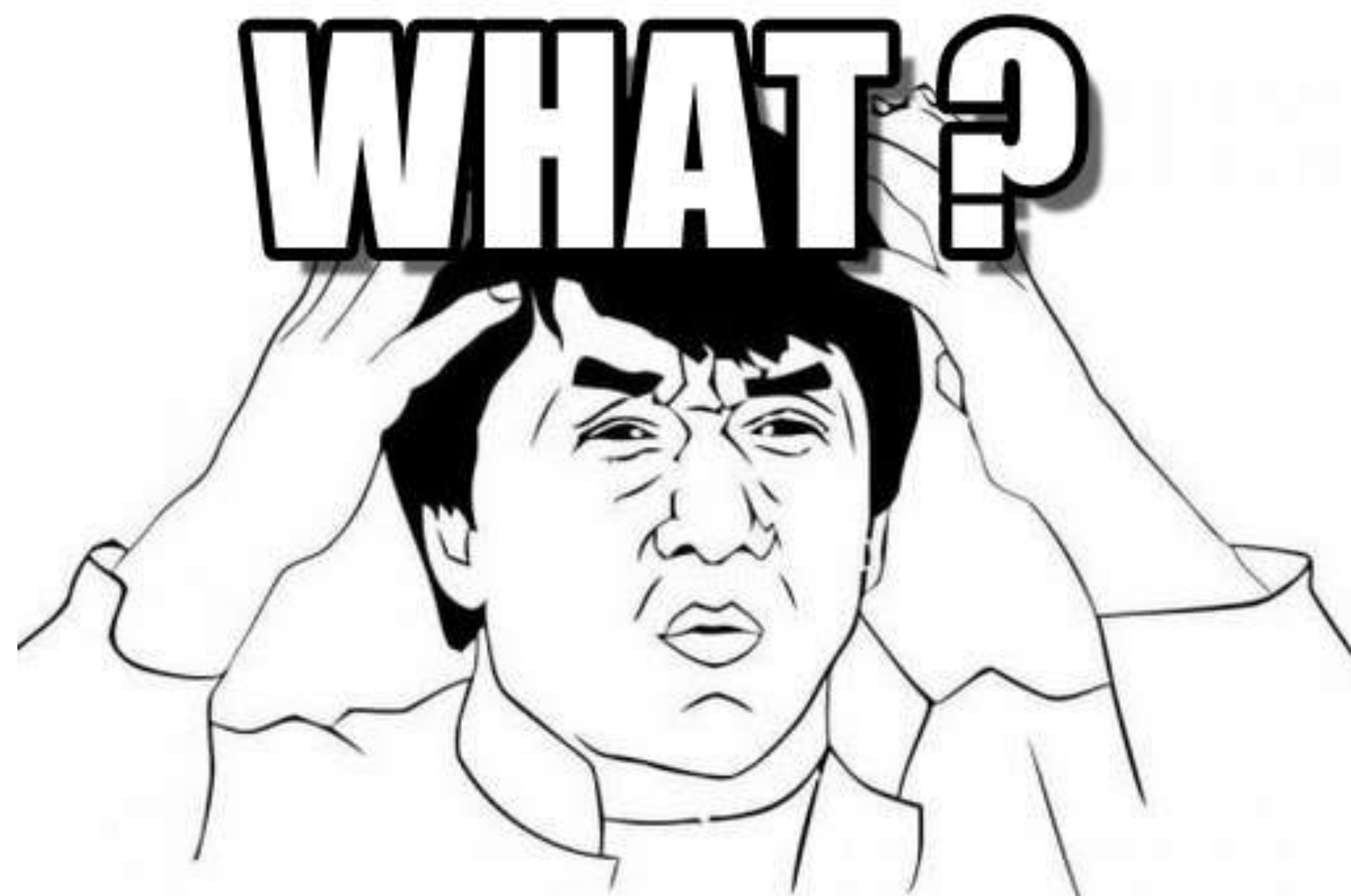


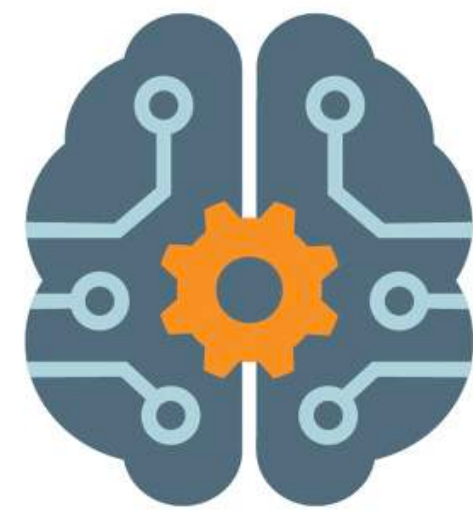
Minimnya data akurat seputar sapi produktif (siap potong) yang dimiliki pemerintah, pribadi, dan swasta.

Let's solve the problems with the
help of "Deep Tech"



But, what is “Deep Tech”?





Artificial Intelligence



Blockchain



Internet of Things

Deep
Tech



Robotics



Chemistry



Life Science



Green Energy

FUTURE FARMS

small and smart

SURVEY DRONES

Aerial drones survey the fields, mapping weeds, yield and soil variation. This enables precise application of inputs, mapping spread of pernicious weed blackgrass could increase wheat yields by 2-5%.

FLEET OF AGRIBOTS

A herd of specialised agribots tend to crops, weeding, fertilising and harvesting. Robots capable of precision application of inputs reduce fertiliser cost by 99.9%.

Precision Livestock Farming (PLF)

Data-driven management of livestock by continuous automated real-time monitoring of production/reproduction, health and welfare of livestock and environmental impact.

FARMING DATA

The farm generates vast quantities of rich and varied data. This is stored in the cloud. Data can be used as digital evidence reducing time spent completing grant applications or carrying out farm inspections saving on average £5,500 per farm per year.

TEXTING COWS

Sensors attached to livestock allowing monitoring of animal health and wellbeing. They can send texts to alert farmers when a cow goes into labour or develops infection increasing herd survival and increasing milk yields by 10%.

SMART TRACTORS

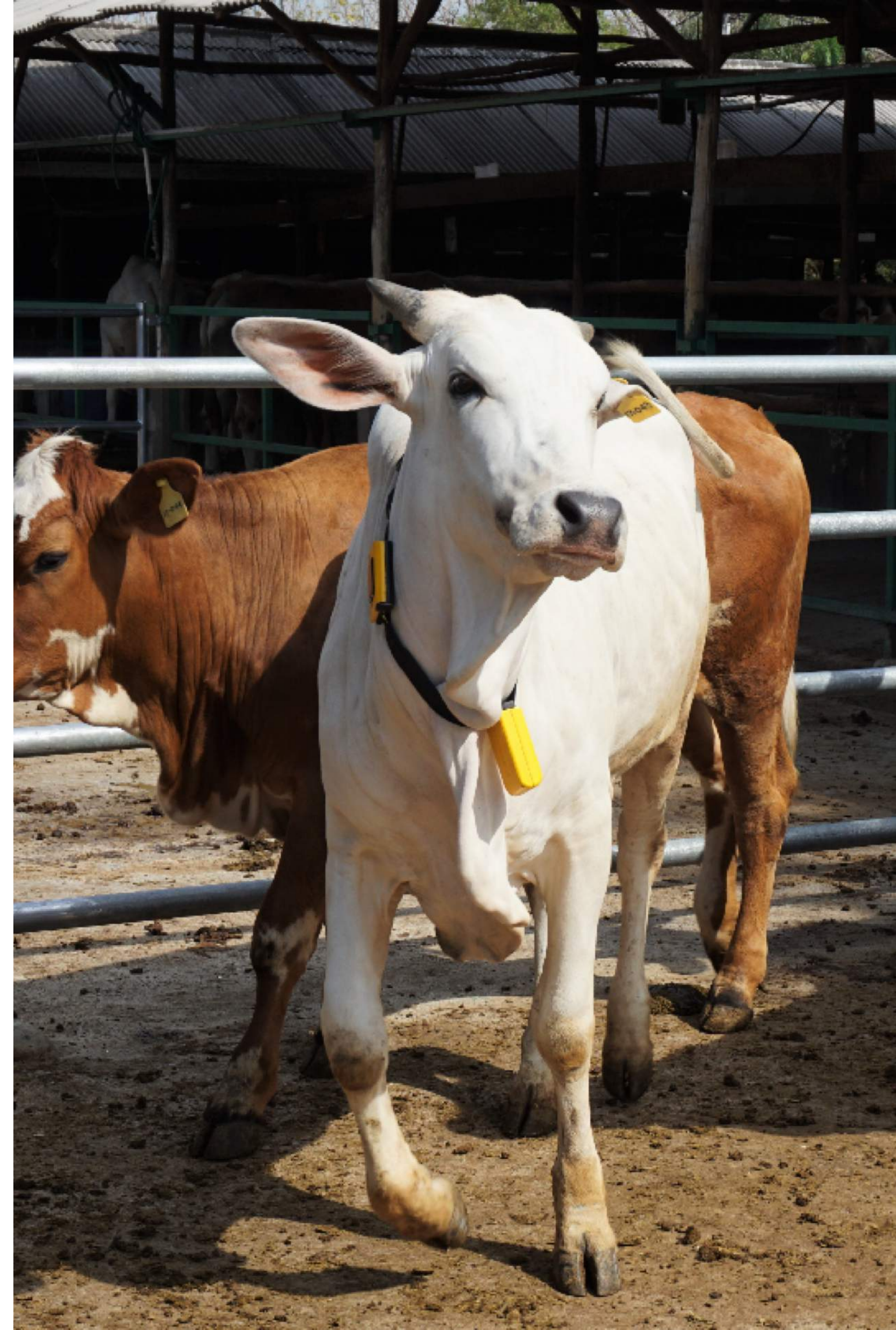
GPS controlled steering and optimised route planning reduces soil erosion, saving fuel costs by 10%.

Introducing...

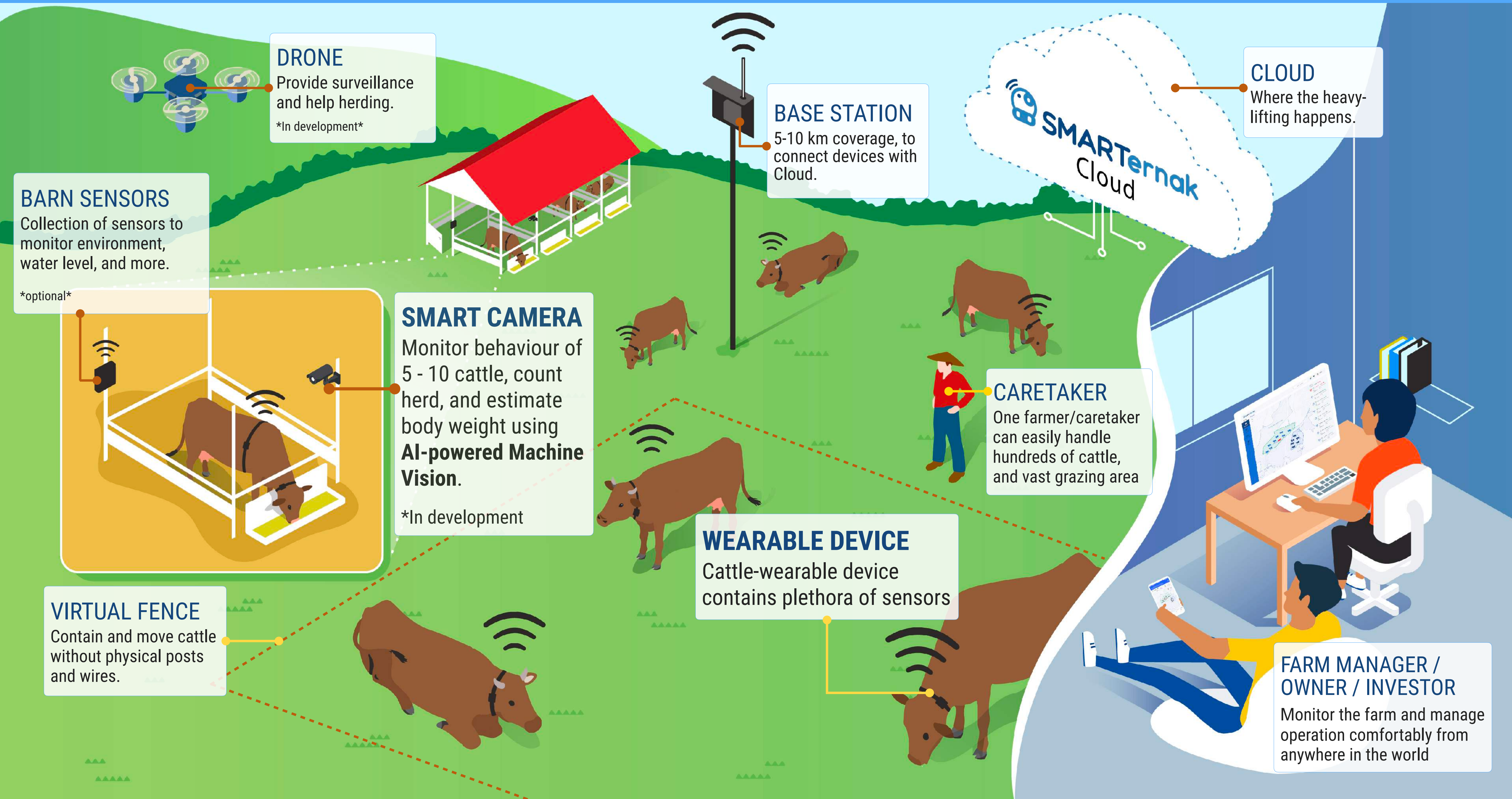


**Internet of Things & Artificial Intelligence-powered
Cattle-Farm Assistance Platform**

* "Ternak" in SMARTernak means "cattle" in Bahasa Indonesia



SMARTernak: 10,000m View



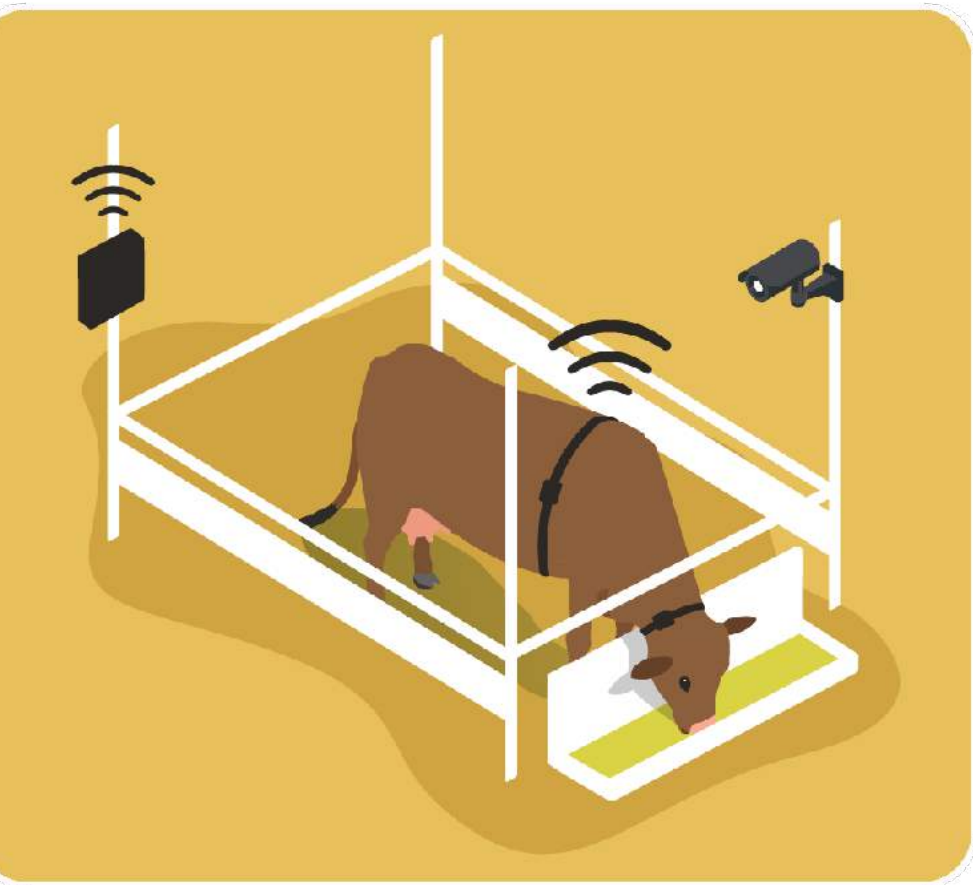
Monitoring & Insights

Monitor cattle where-about & well-being

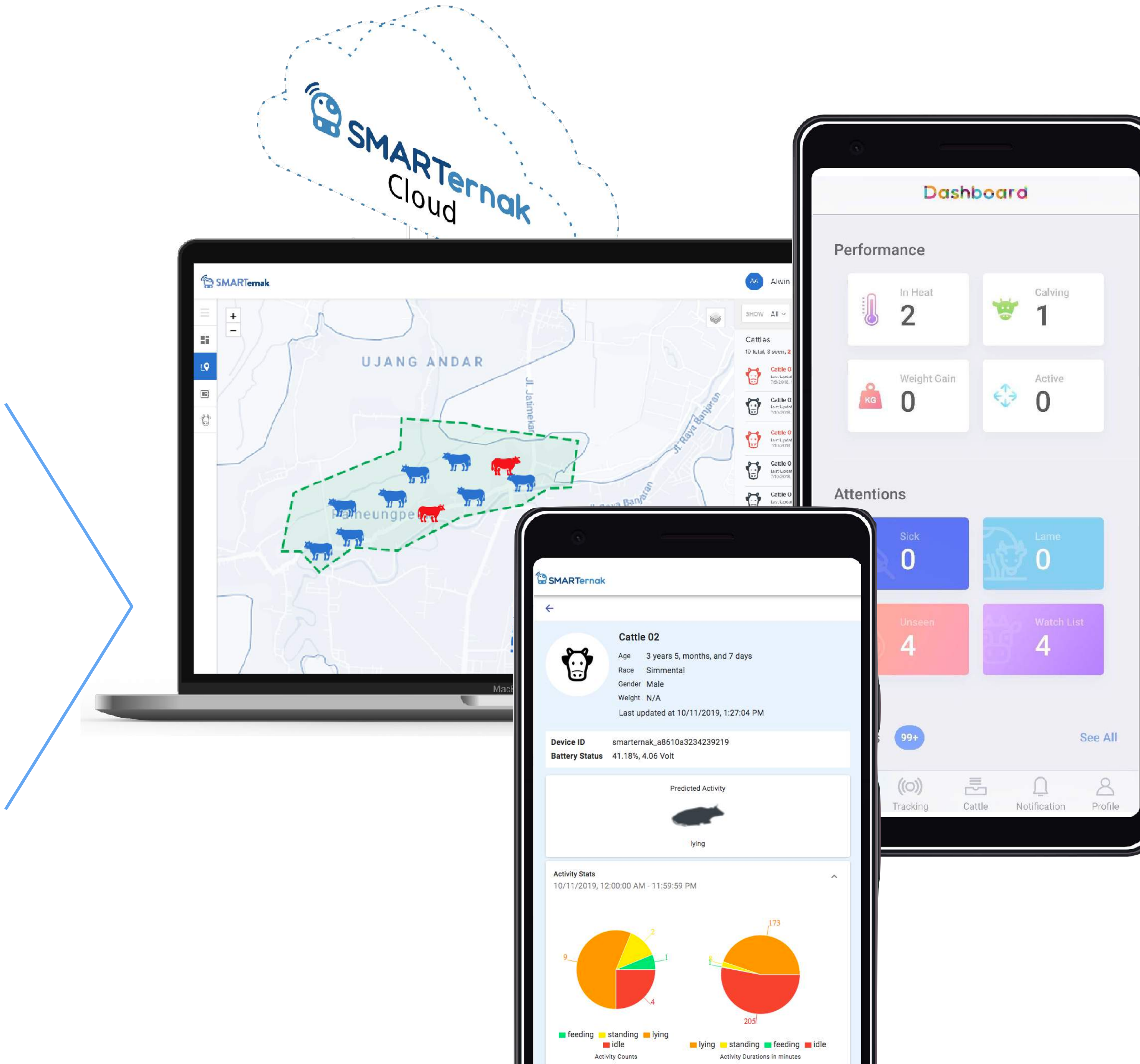
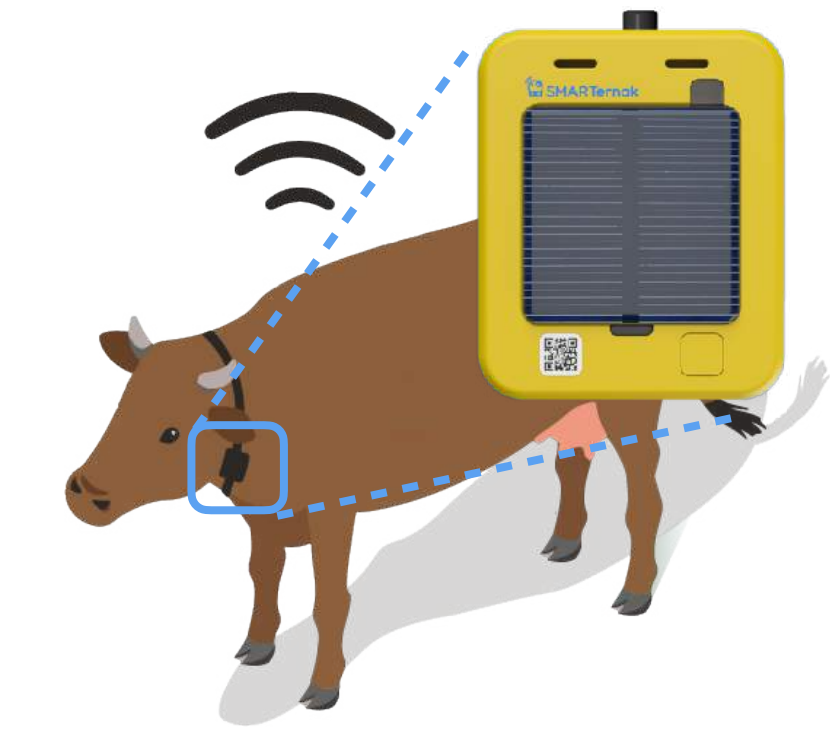
Provide insights - powered by AI
farmer doesn't really care about (raw) data

On-farm Smart Camera:
Monitor activity of 5 - 10 cattle - focus on group activity
Count herd & movement
Estimate weight*

Barn Sensors:
Monitor ambient temperature, humidity, and air quality in barn
Monitor food & water level



Cattle-wearable device:
Precisely monitor each cattle for:
Location (latitude, longitude, movement speed, direction)
Body temperature
Ambient temperature & humidity
Ambient light & sound
Movement (linear acceleration, angular velocity, direction)
Chest Circumference
Device removal status
Battery voltage & capacity



Cattle-wearable Device

Dual IoT Connectivity

Short Range: Bluetooth v5, BLE
Long Range: **LoRa/LoRaWAN** or **NB-IoT**,
for 5-10km coverage area

Powerhouse

Ultra low power Microcontroller
with on-device Machine Learning capability

Packed with Sensors

GPS / GNSS
Accelerometer, Gyroscope, Compass
Body Temperature
Ambient Temperature & Humidity
Barometric Pressure
Ambient Light
MEMS Microphone
Device Removal Detector

Smart Energy

Battery Gauge
Solar Energy Harvesting
Smart Switching Between
Main & Backup Battery
Fast Charging from USB Type-C
Firmware-optimised
power consumption

Actuators

Audio Alert via Buzzer
Color LED

Enclosure

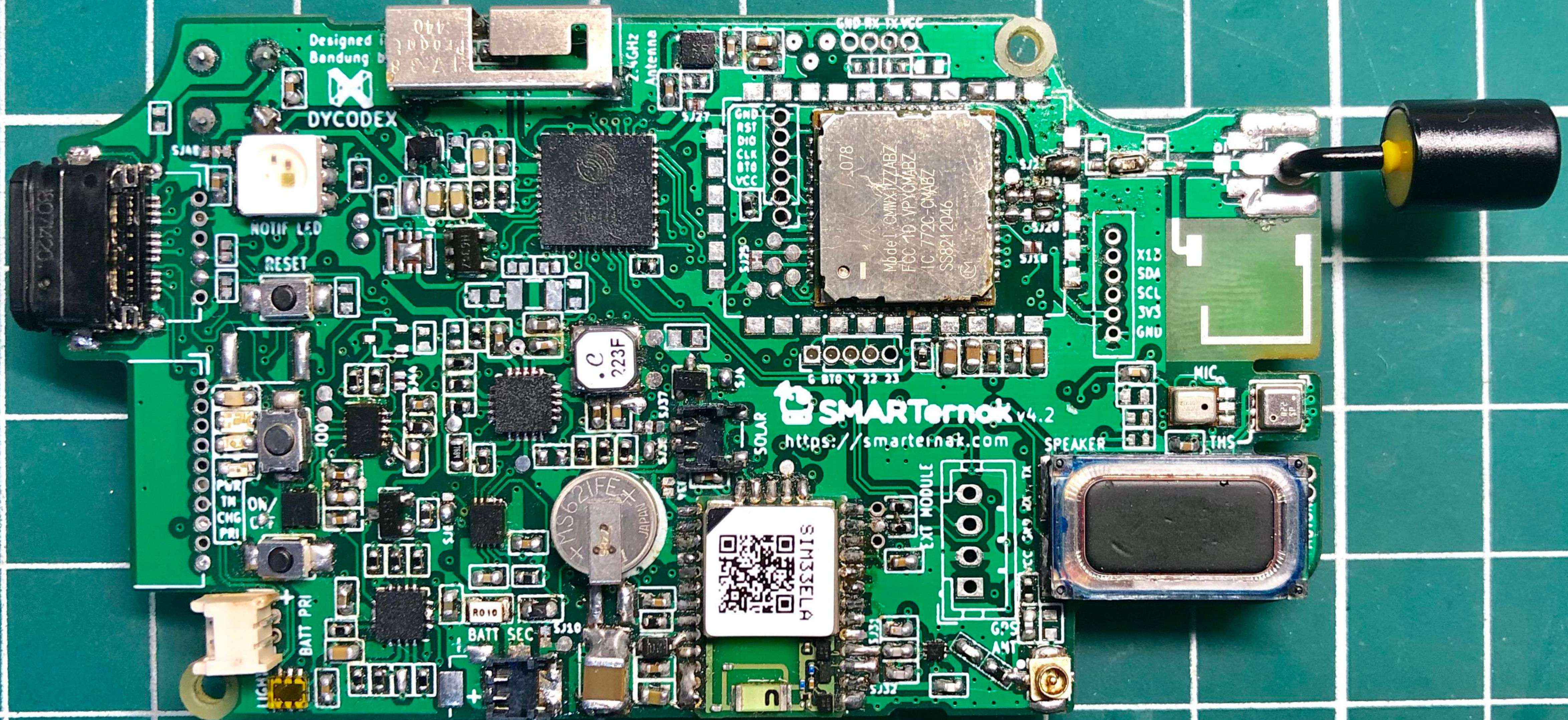
Waterproof &
submersible (IP67)



*But SMARTernak is about platform.
It's open to 3rd party devices.*

Device Internals

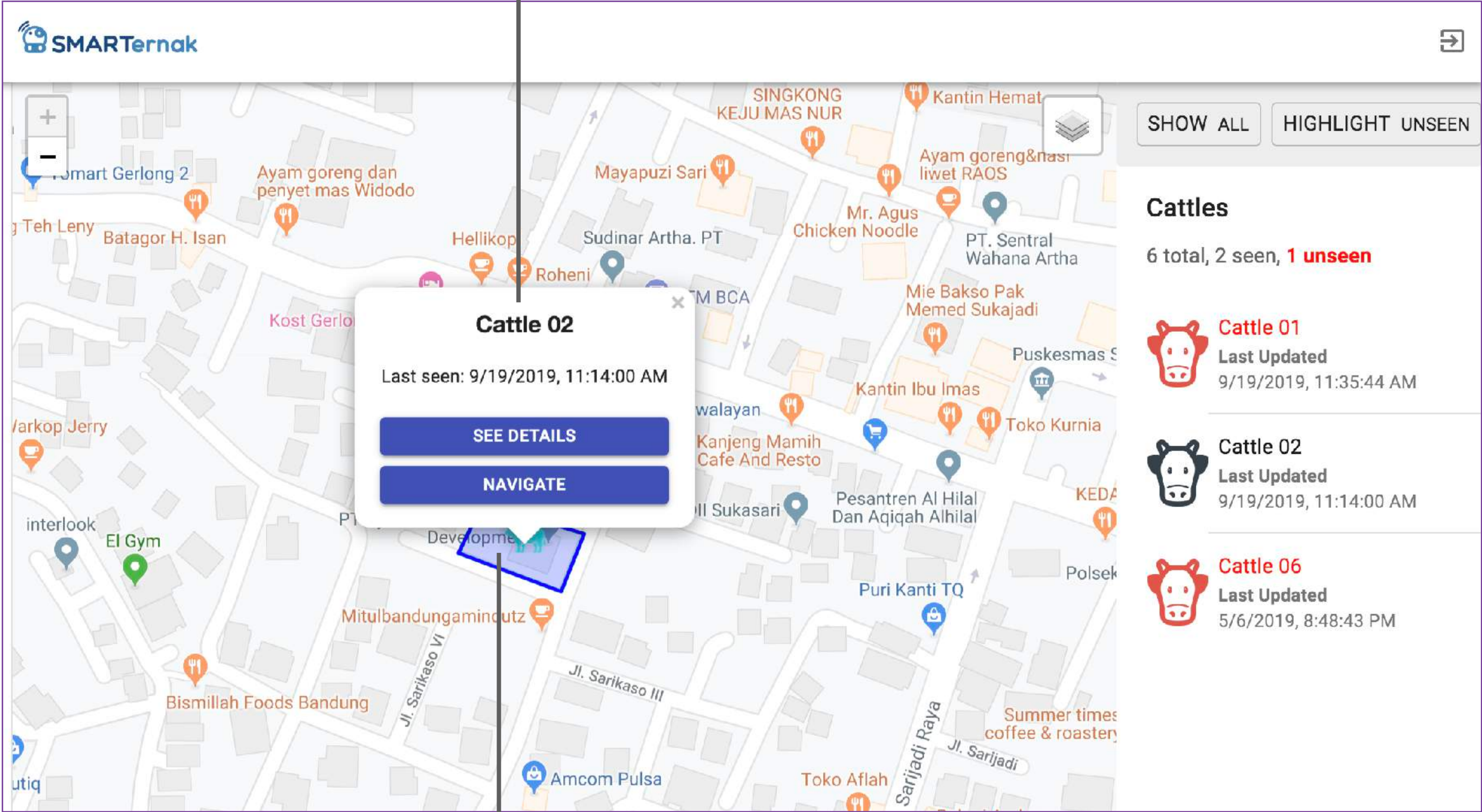
Hardware is 100% designed in-house, mass-produced in Indonesia, by 100% Indonesian



Cattle Location Tracking

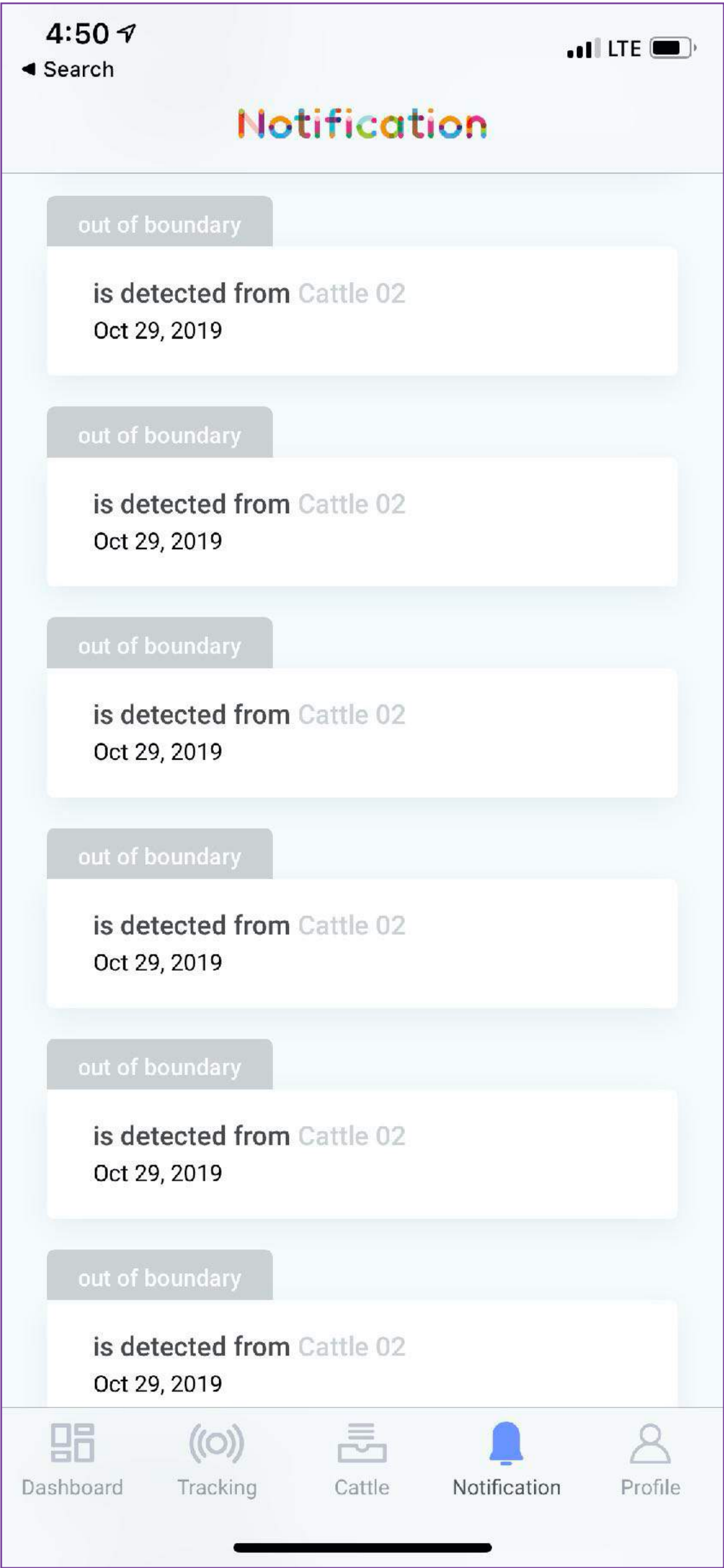
Precisely locate cattle

No need to check cattle physically,
to increase productivity



Virtual geofencing:

- Virtual and remote herding
- Alert upon cow out of area
- Precise herd counting, no cattle left behind
- Less physical (electrical) fence

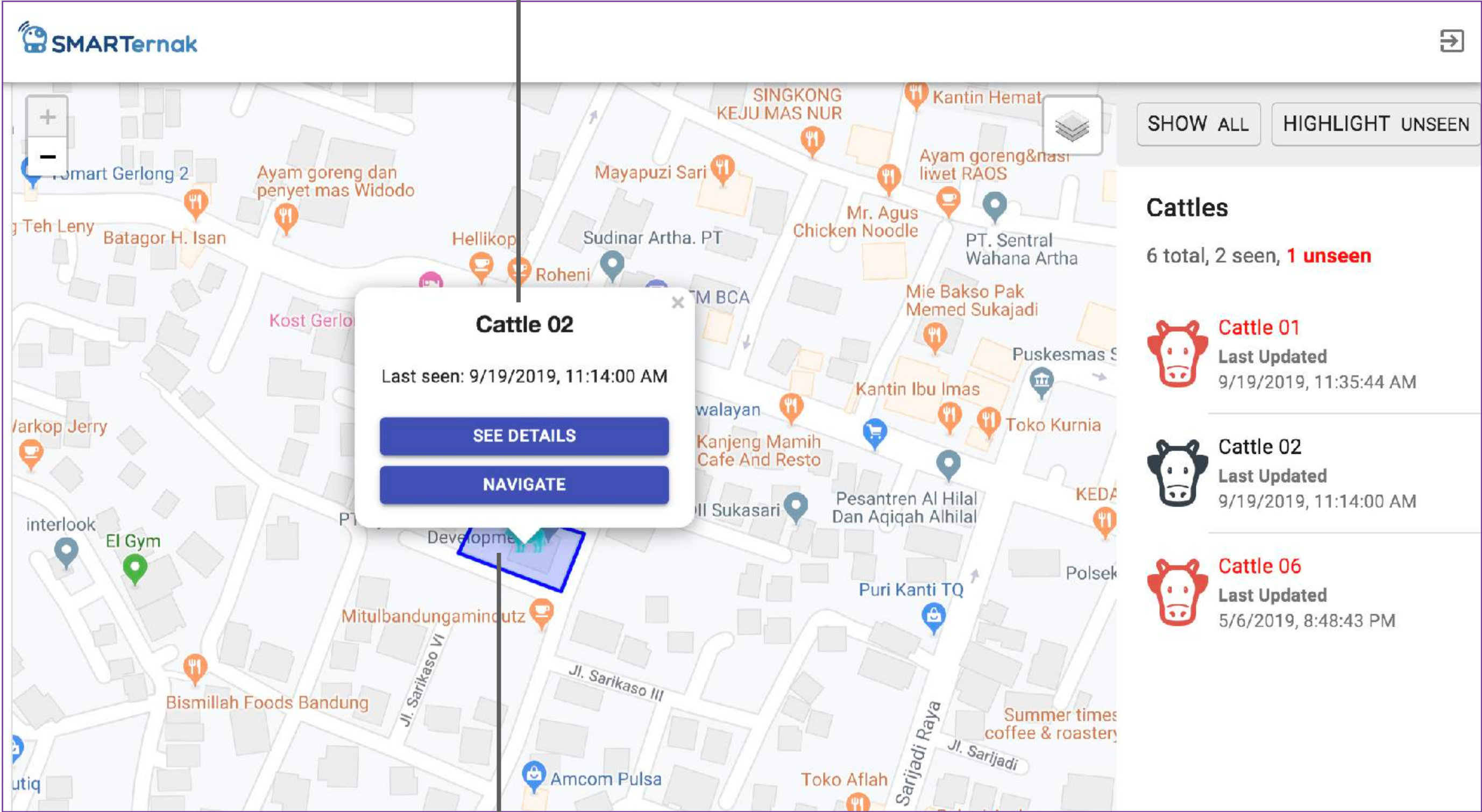


Out of area alert

Cattle Location Tracking

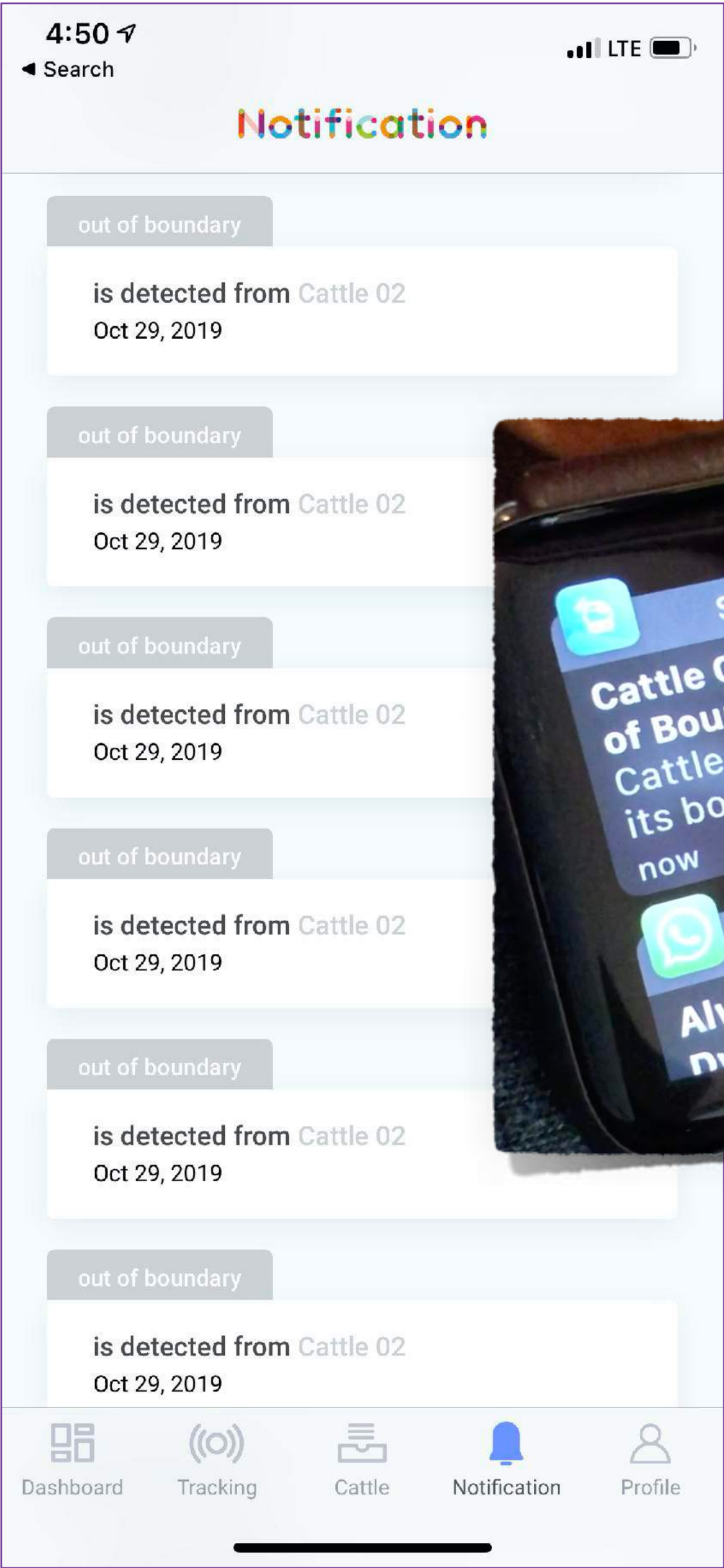
Precisely locate cattle

No need to check cattle physically,
to increase productivity



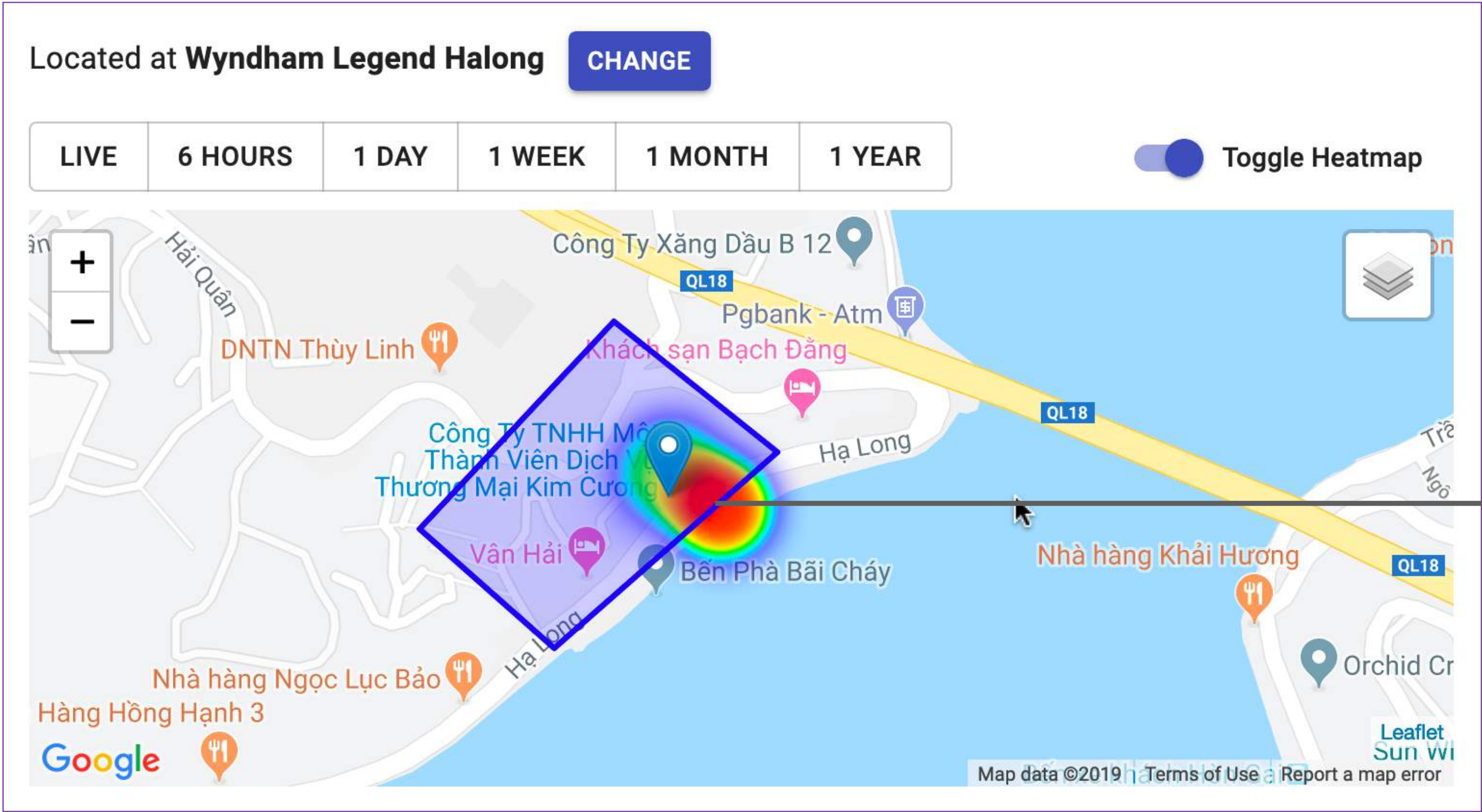
Virtual geofencing:

- Virtual and remote herding
- Alert upon cow out of area
- Precise herd counting, no cattle left behind
- Less physical (electrical) fence



Out of area alert

Cattle Grazing Activity



Grazing activity

- Monitor & control grazing pattern, giving time for food to grow, ensuring sustain supply
- See the distance walked over time compared to other cattle
- Receive notifications when cattle hasn't moved for a while.

Tracking - Benefits

Animal welfare

Less or even no need physical fence,
esp. electrical fence that may cause trauma

No risk of cattle stuck in fence

Missing/left cattle can be identified and
found in no time

Tracking - Benefits

Profit

Productivity increase:

No need to visually check cattle. Existing care-takers can handle more cattle, no need to add more.

Grazing pattern is controllable:

Ensure food source is sufficient for healthy cattle.
Give time for grass to grow.

No more missing cattle:

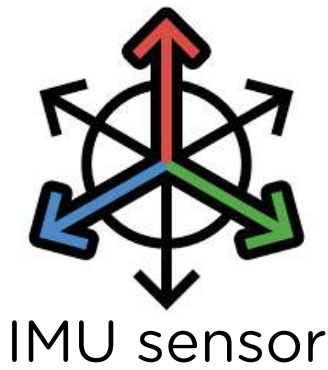
Prevent missing or stolen cattle

Less or not physical fence:

Reduce cost to install and maintain fence

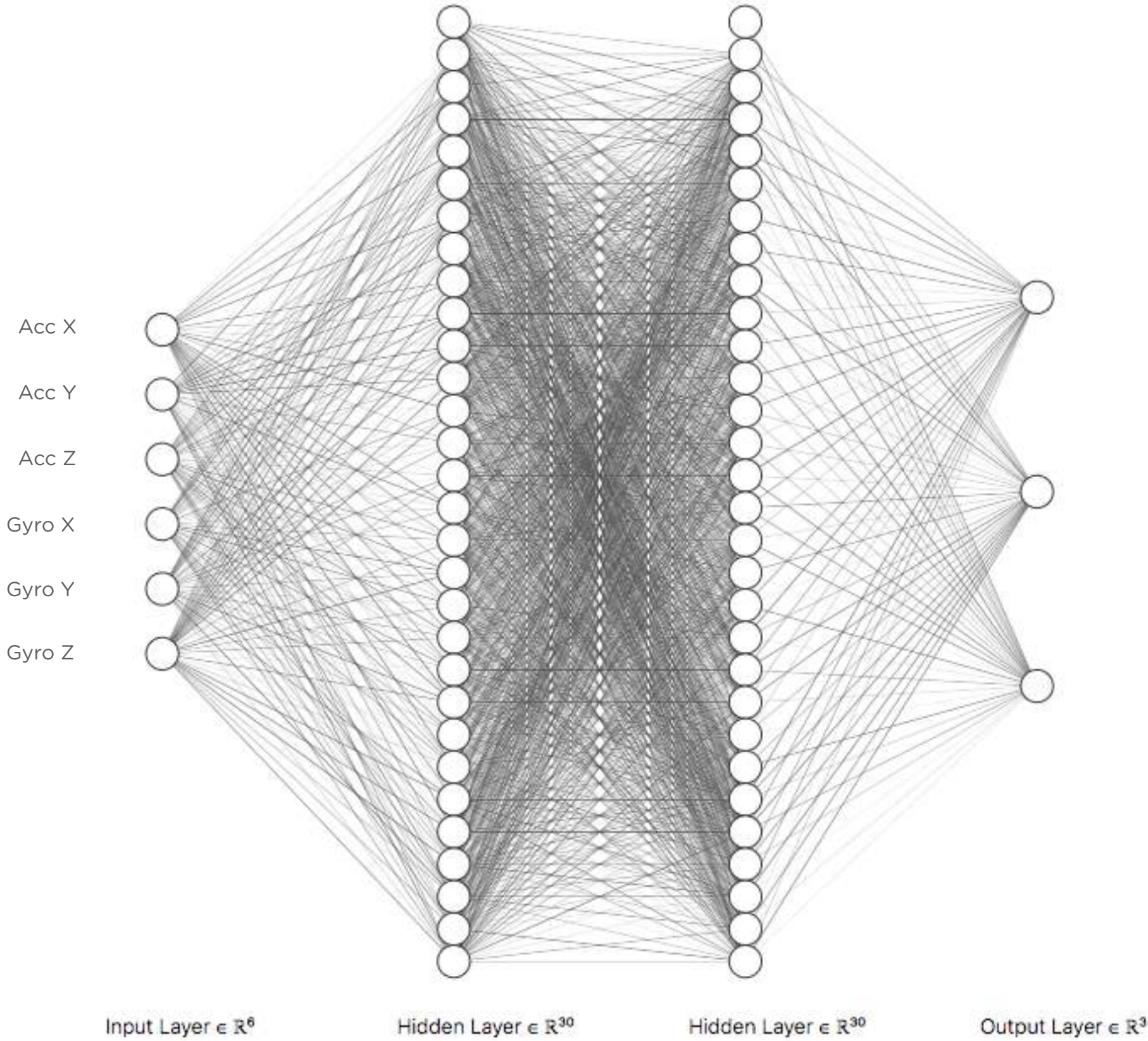
Artificial Intelligence at The Edge

Learn & recognize cattle behaviours to tailor actionable insights & recommendation based on sensor data with the help of on-device Artificial Intelligence

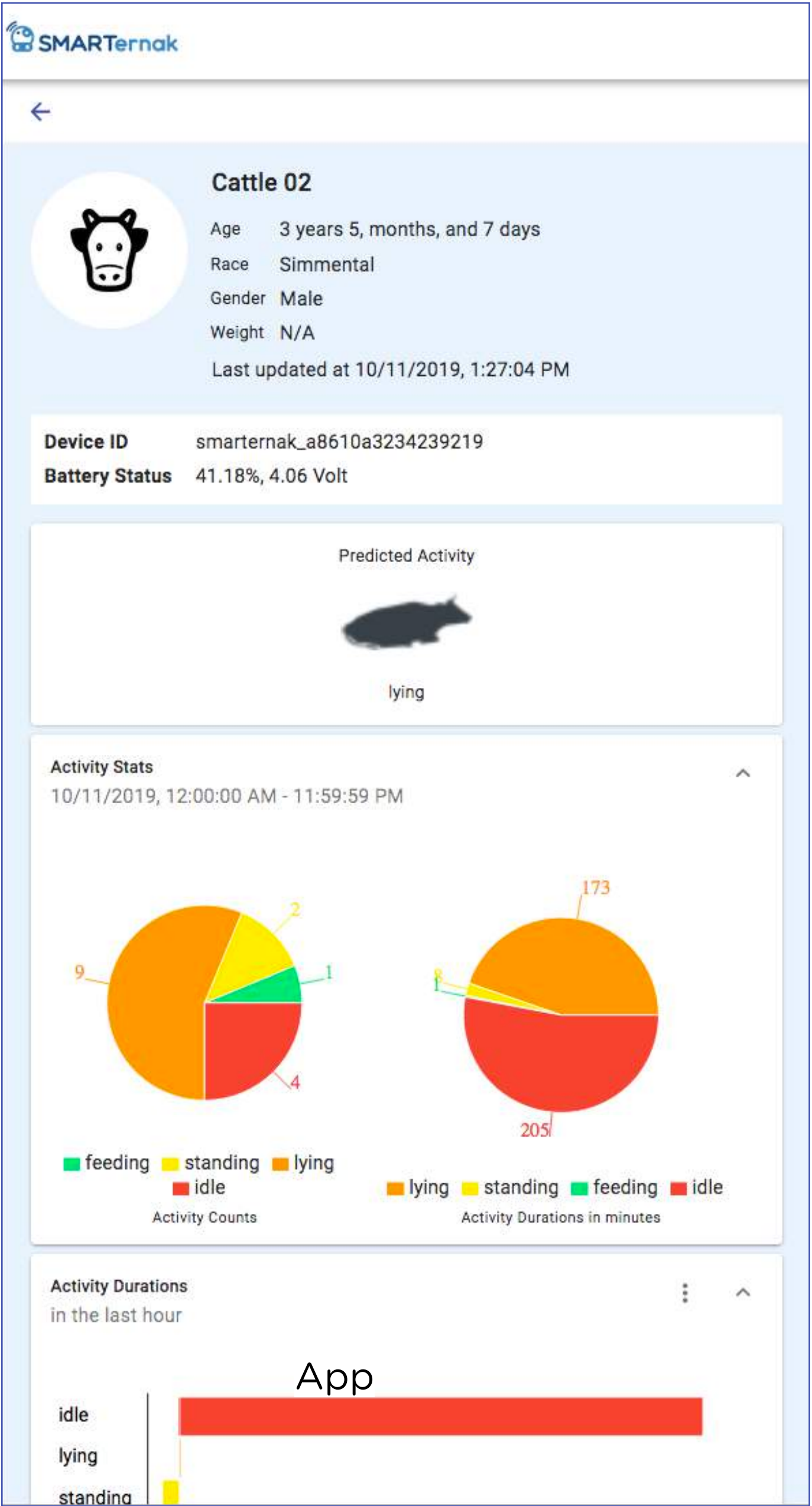


IMU sensor

Motion captured by
Inertial Measurement Unit (IMU) sensor
inside cattle-wearable device



Deep Neural Network
Inference right on the device



Activity Insights
(standing, lying-down, feeding, and more)

Cattle 02

Age 3 years 5, months, and 25 days
Race Simmental
Gender Male
Weight N/A
Last updated at 10/29/2019, 12:00:06 AM

NAVIGATE

Device ID smarternak_a8610a3234239219
Device Name smarternak_a8610a3234239219
Battery Status 18.53%, 4.05 Volt

Predicted Activity



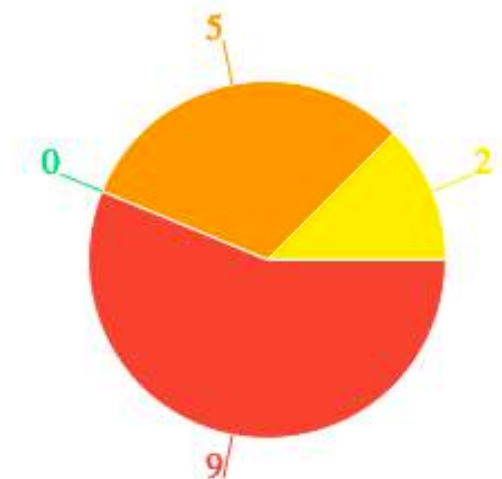
standing

Animal activity recognition

No need to visually observe the animal

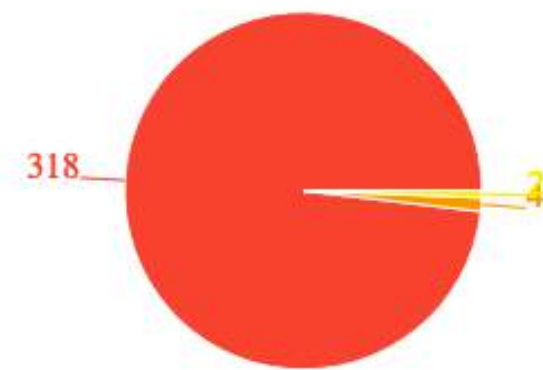
Activity Stats

10/29/2019, 12:00:00 AM - 11:59:59 PM



walking lying feeding
idle

Activity Counts



idle lying walking

Activity Durations in minutes

Activity stats:

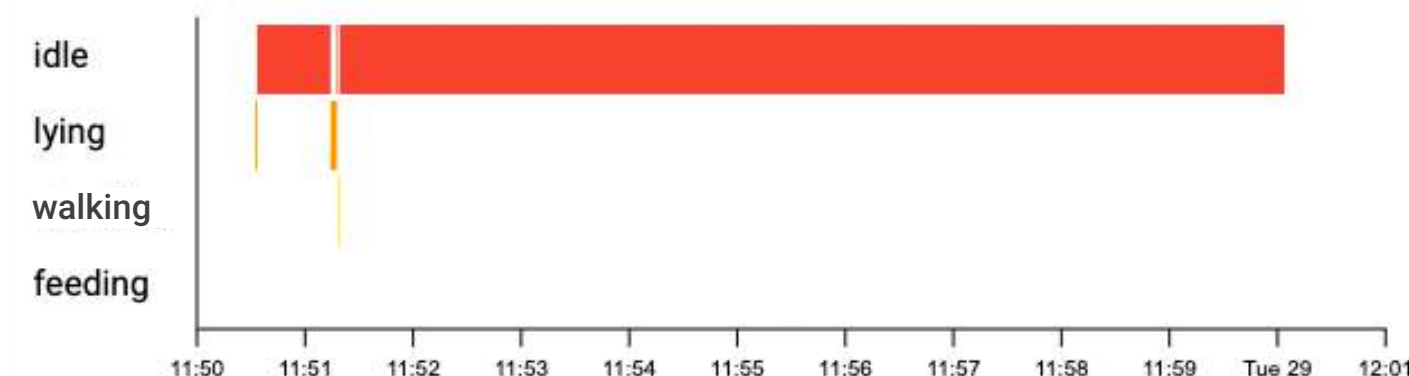
Activity count and duration statistic during certain timespan

Activity duration and switching. Can be used for determining symptoms of possible health issues.

Alert when animal has stopped moving, not feeding, not enough activity, in-heat, and more

Activity Durations

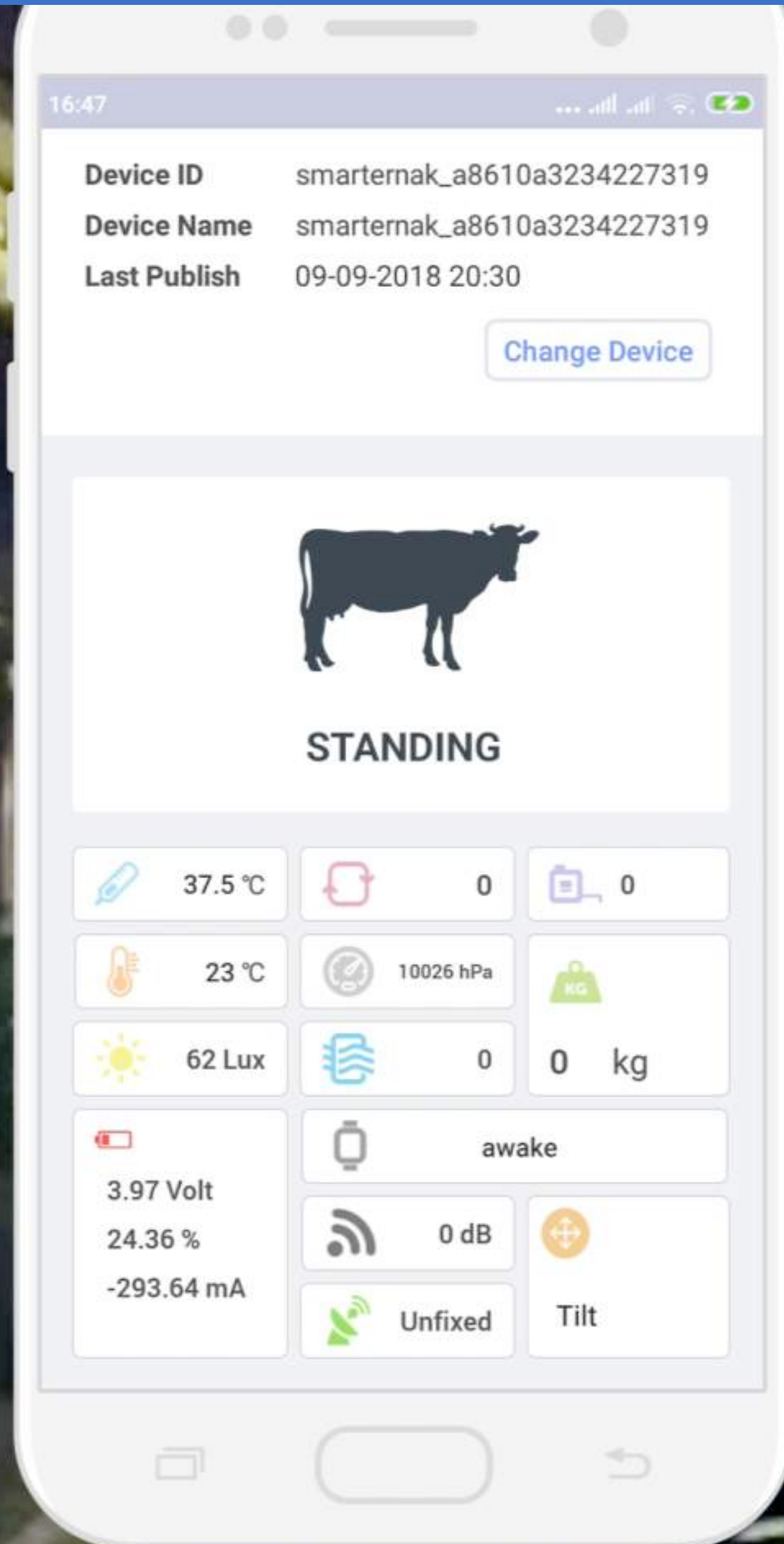
in the last hour



On-device Activity Prediction

Using Artificial Intelligence and deep learning with Tensorflow, SMARTernak can detect and learn cattle behaviour and analyze the data into actionable insights and recommendations to improve efficiency and reduce loss.

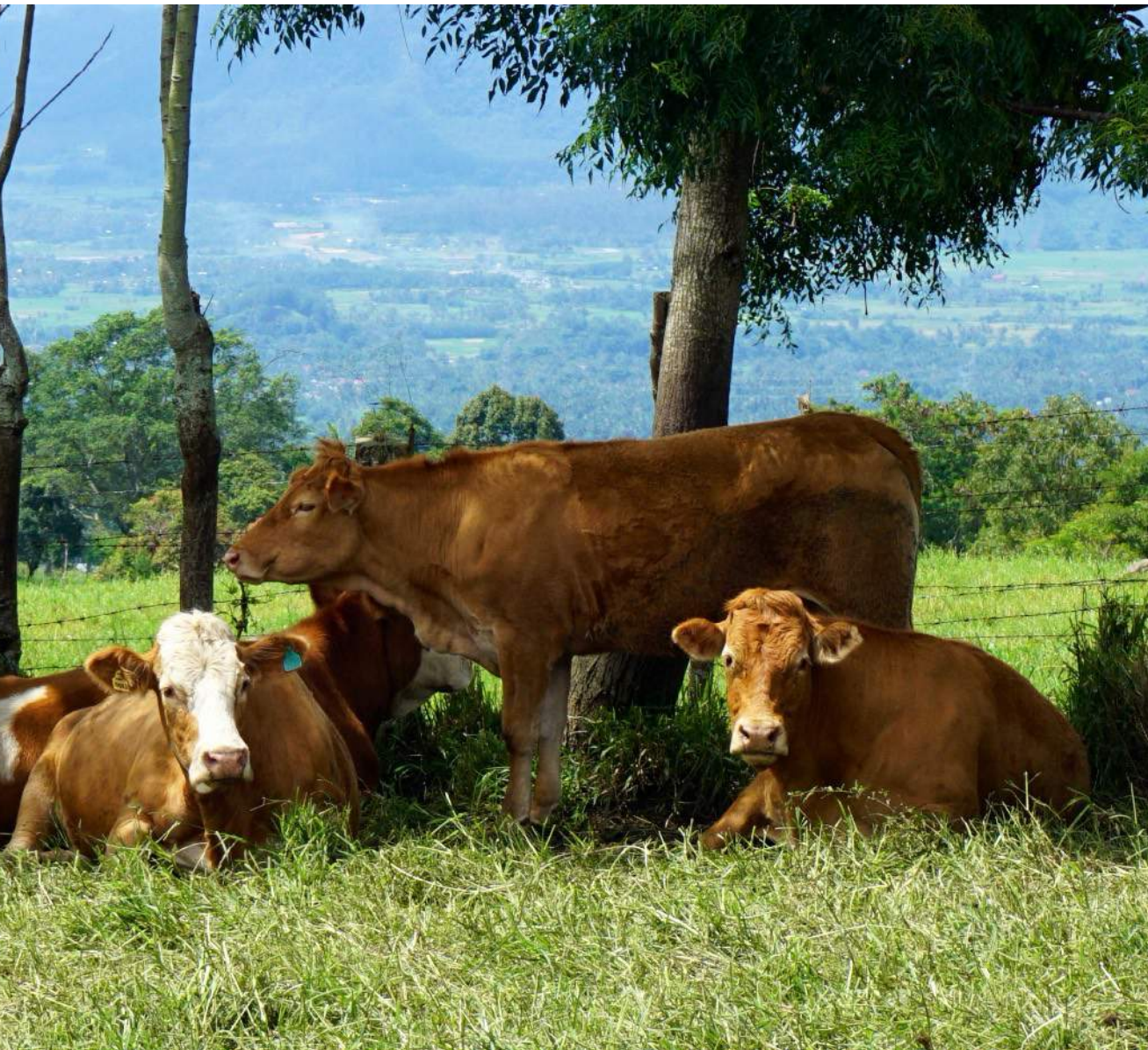
Demo Video: <http://bit.ly/smrtrnk-ai-1>



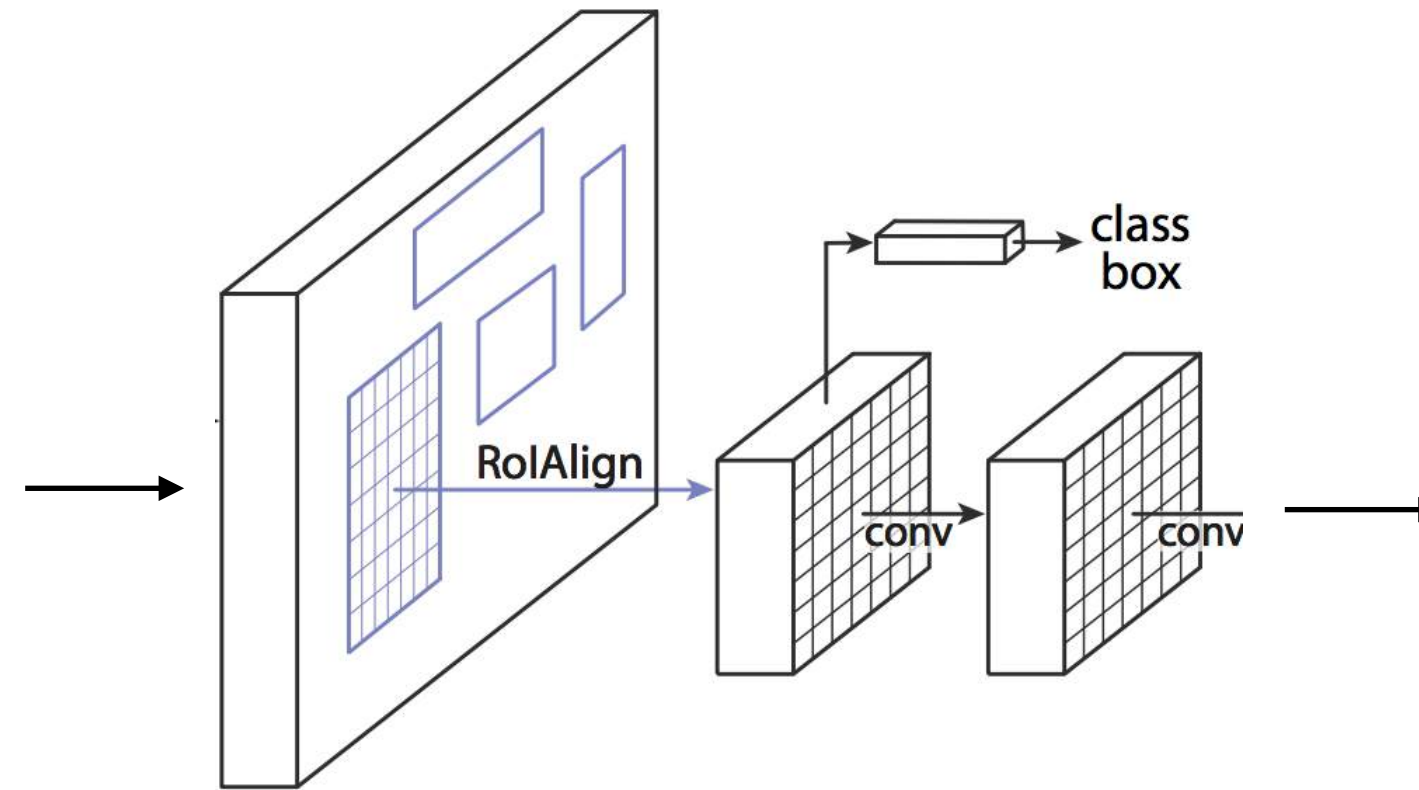
Actual footage taken from SMARTernak field trial live feed at PT. Sumber Hijau Mandiri on September 9, 2018. SMARTernak smartphone app overlay is an illustration of real-life usage.

On-farm Smart Camera

Cattle Counting & Behaviour Analysis using on-farm camera
with the help of Machine Vision & on-device Artificial Intelligence



Image/video stream from camera



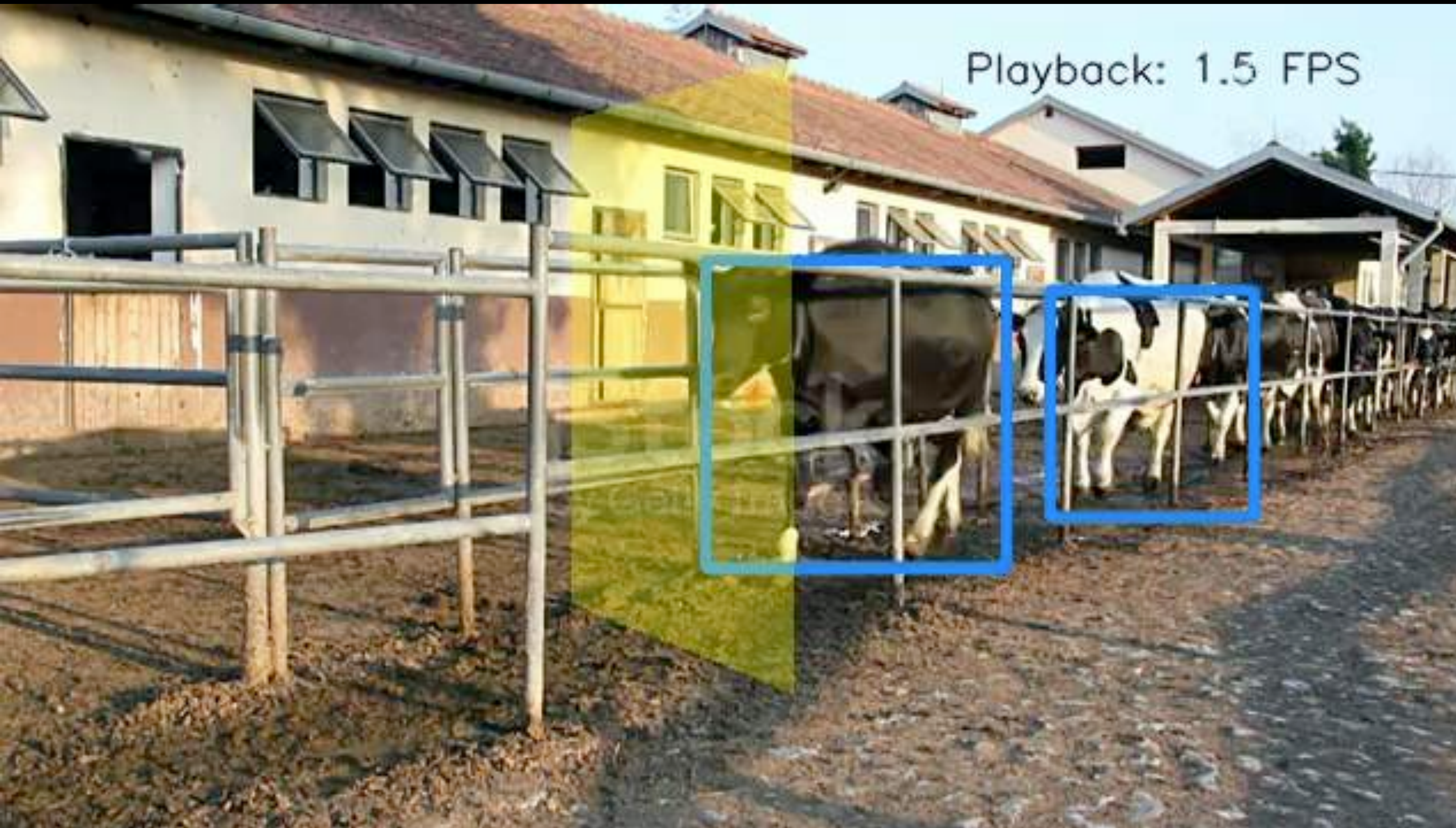
Deep Neural Network
(Object Detection & Tracking,
Instance Segmentation -
inference right on the device)



Detected cows and predicted activity
(standing, lying-down, feeding, ...)

**In development*

Smart Camera Use Case - Cattle Herd Counting



- ☒ Play Video
- ☒ Repeat
- ☒ Detection
- ☒ Tracking
- ☐ Full screen
- ☒ Save

Draw Fence



*Screen capture of app UI
running in Smart Camera*

Demo Video: https://youtu.be/Yk3O_HImSK8



Ciawi, West Java



Bantul, Yogyakarta



Subang, West Java

**SMARTernak
Real-World
Implementation**



Majalengka,
West Java

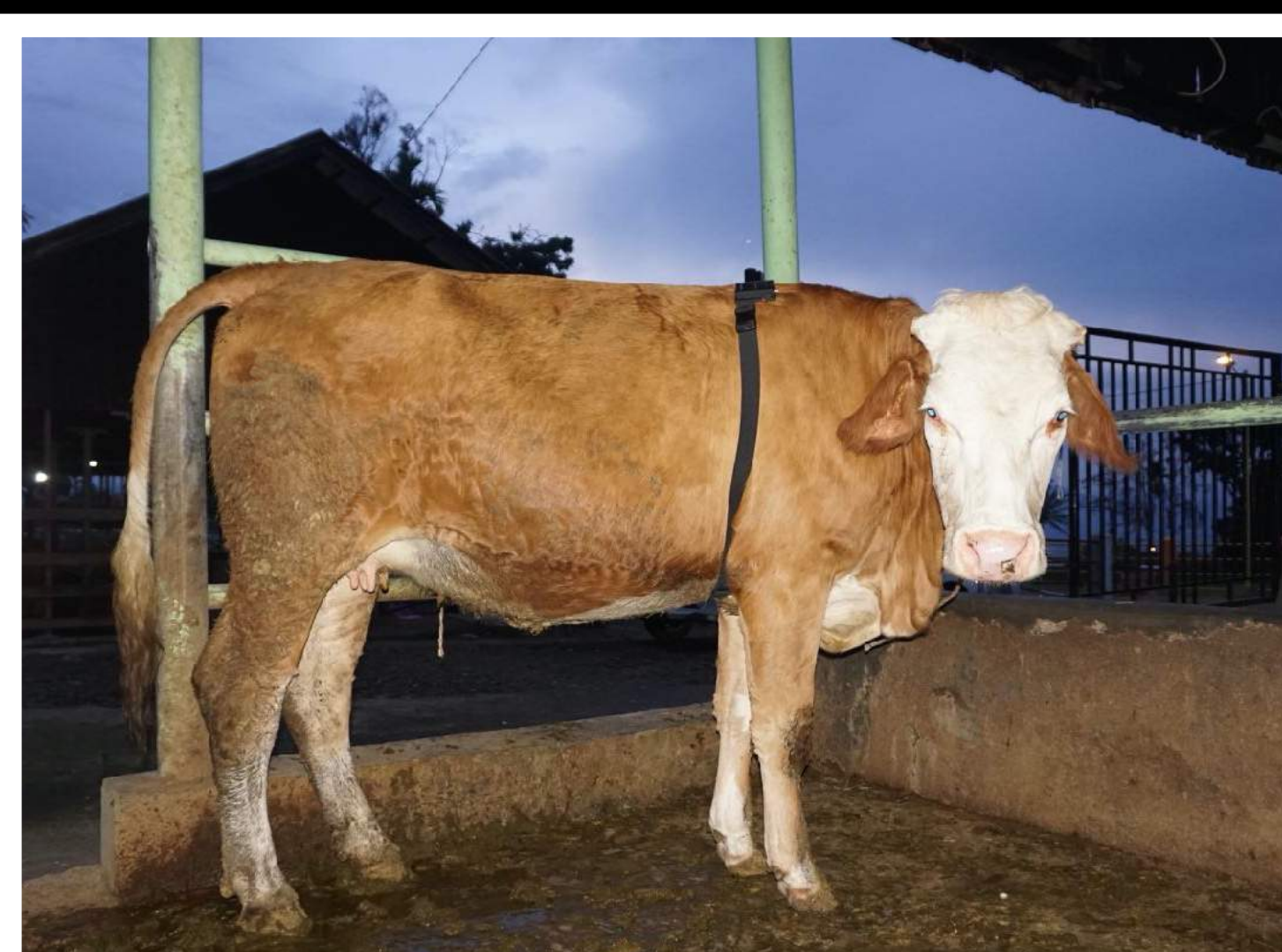
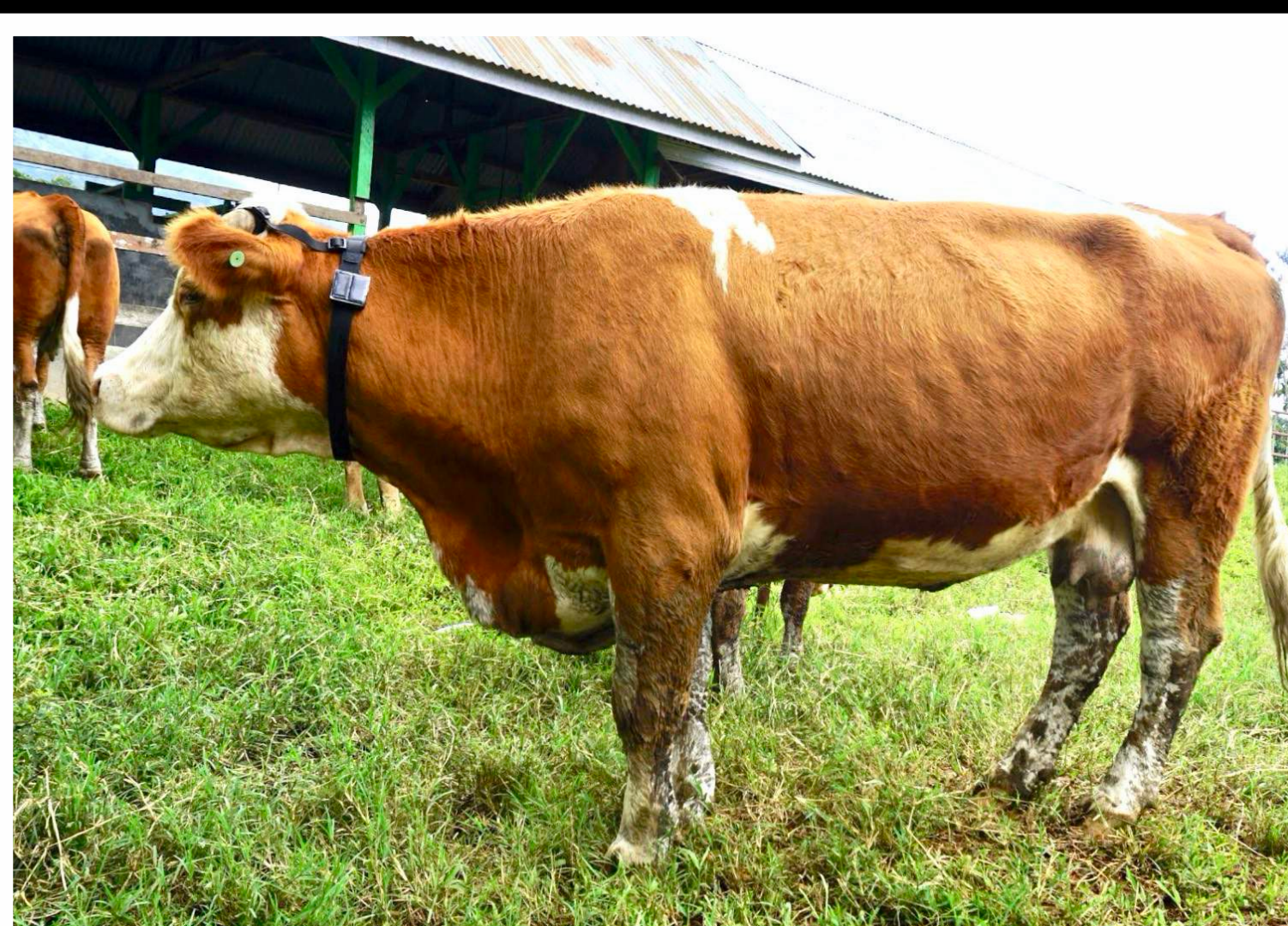


Padang Mengatas,
West Sumatera

Ministry of Agriculture's Cattle Breeding & Food Center

at Padang Mengatas, West Sumatera, Indonesia

in collaboration with Ministry of ICT (KEMKOMINFO), supported by Ministry of Agriculture



BPPIBTSP Bunikasih, West Java Province

at Cianjur, West Java, Indonesia, Dec 2019

in collaboration with **XL Axiata** for 1st implementation of Desa Digital – Livestock



Ridwan Kamil, West Java Governor



ridwankamil • Follow



IMPLEMENTASI "DESA DIGITAL" MENERIMA AWARD OF EXCELLENCE 2019 dari OpenGOV, institusi internasional di bidang inovasi pemerintahan. .

INOVASI ini adalah salah satu yang mengangkat 537 desa naik kelas dari desa berkembang menjadi status desa maju dalam waktu 10 bulan.

Award ini didedikasikan untuk semua pihak yang bekerja keras melalui kolaborasi Pentahelix.

MARI SEMANGAT, jika desa juara maka Insya Allah #JabarJuara.

3d



56,804 likes

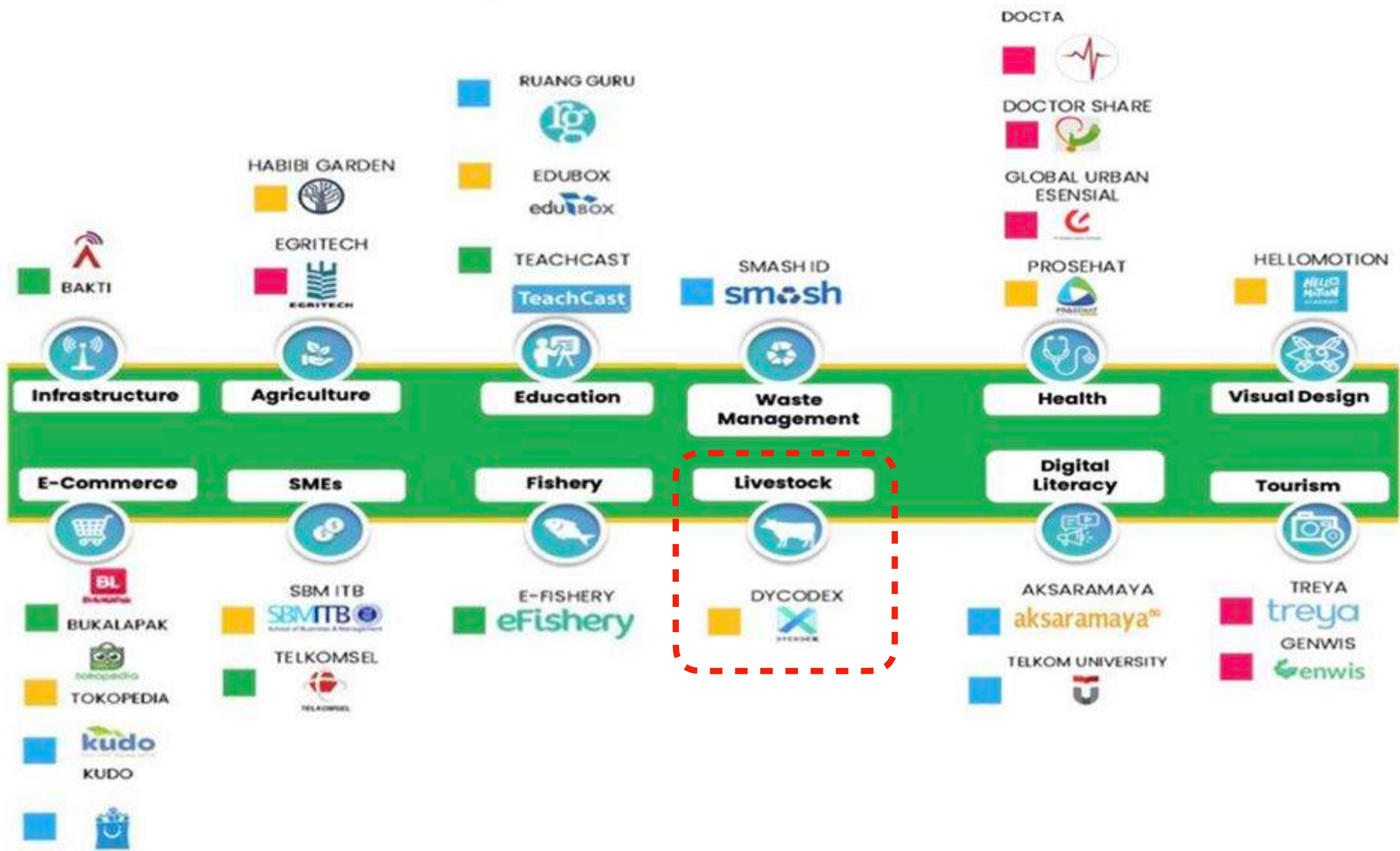
3 DAYS AGO

Log in to like or comment.

Digital Village

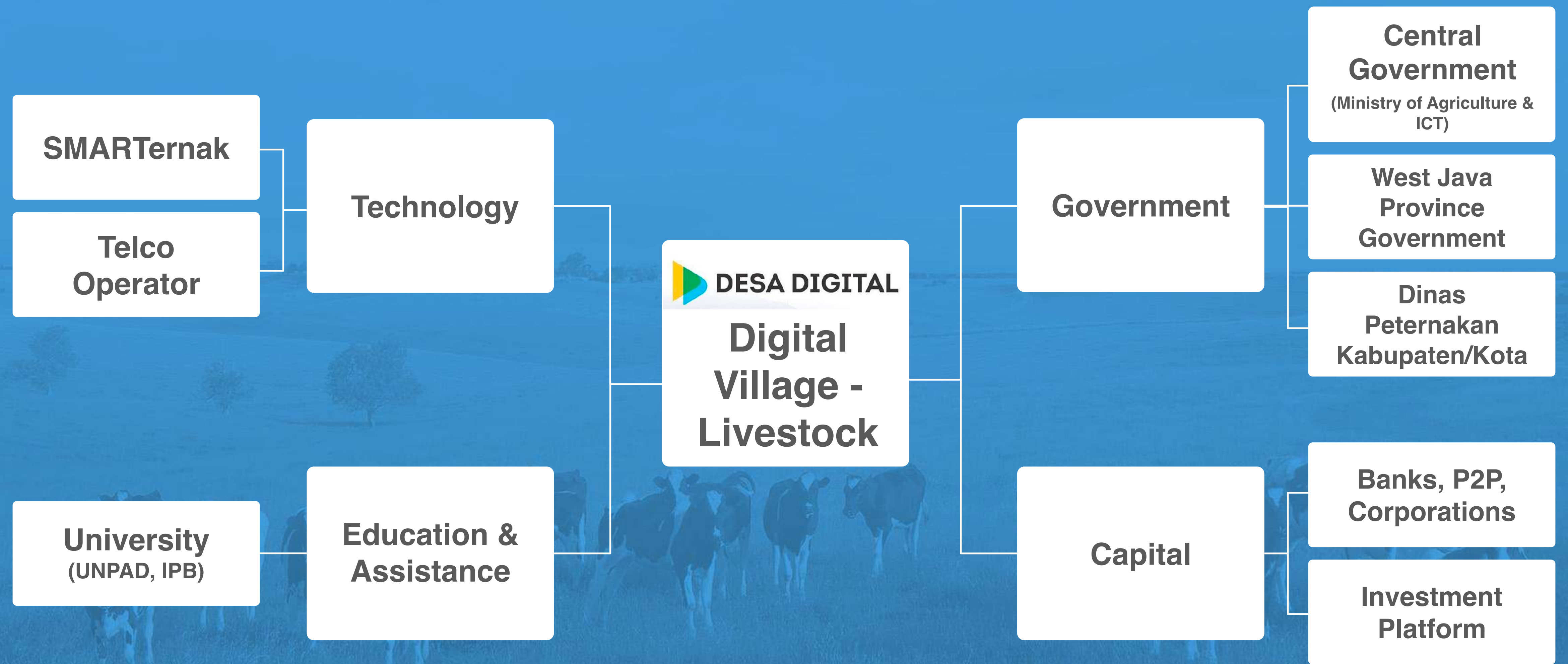


Digital Village Partnerships



Digital Village - Livestock Farming

In progress to work with **West Java Government** - Digital Service Division, for an initiative of “Digital Village - Livestock” to tap the cattle farming potentials in West Java, which is the **2nd largest** in Indonesia



Coverage by Metro TV in Ciawi, Bogor

Watch here:

<https://www.metrotvnews.com/play/b3IUoePr-asli-lokal-kualitas-global-1>

<https://www.metrotvnews.com/play/NQoUnOEY-asli-lokal-kualitas-global-2>

START

 Long Range
Low Power IoT
Connectivity



Cattle Activity Recognition



Activity &
Performance Insights

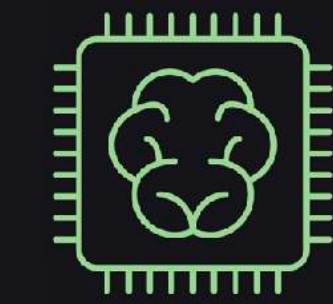
 **NB-IoT**
with 2G Fallback

 **LoRaWAN**[™]

 GPS & Compass



SMARTernak
Wearable

 On-device
Artificial
Intelligence

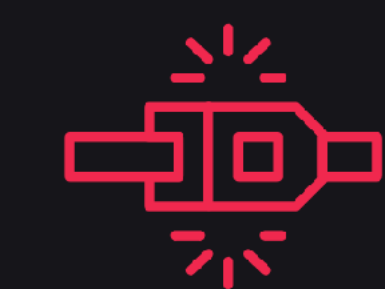


Sits firmly on cow's neck

 Notify Cattle
Health-related
Issues



Virtual Geofencing
Out of Area Alert, Herd Counting
& Grazing Insights

 Device
Removal
Alert

CPU 64 MHz Cortex-M4F				
AES Co-processor	RAM 256kB	Crypto		
NFC-A Bluetooth 5				
		DC-DC Buck Converter	1 MB Flash	

All-1/2-year Battery Life
and some more, with energy harvesting from solar



Sense Surrounding Environment



Smart Energy
with Backup Battery &
Energy Harvesting

**Health
Tracking
Ultimate**
3 variants for all farm types

**Weight
Progress
Estimation*** 

SMARTernak Variants

Core features

- Cattle position tracking
- Virtual geofencing
- Herd counting
- Grazing insights
- Activity insights
- Behaviour insights
- Health insights
- Surrounding environment monitoring
- Weight gain insights (beta)
- Device removal alert
- Rich web-based dashboard
- Android & iOS app

Additional features

- Energy harvesting from solar
- Additional battery lifetime
(smart energy management + backup battery)

Subscription features (Rp83K / month / cow)

- Access to web dashboard and mobile apps, and all future
- On-site training, assistance, support
- Device warranty and support

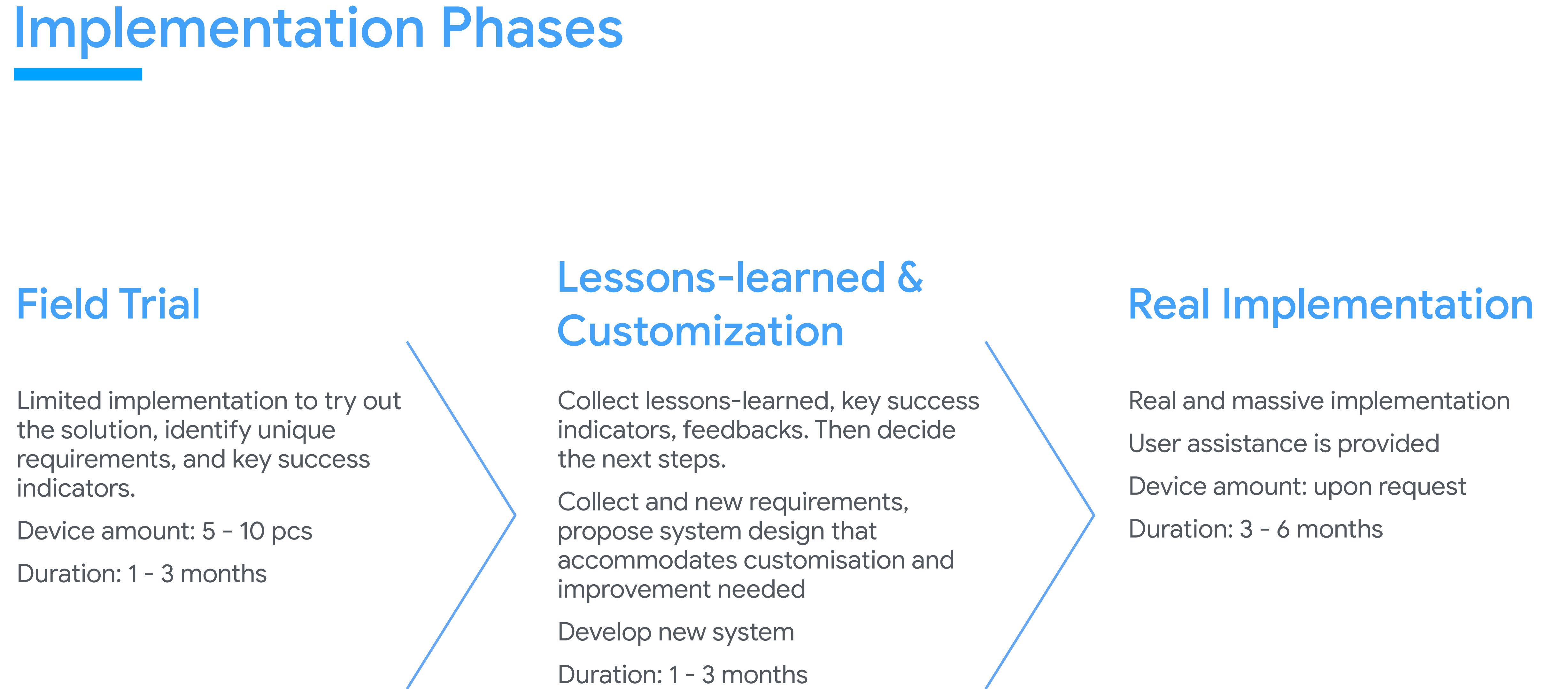
SMARTernak Tracking	SMARTernak Health	SMARTernak Ultimate
Rp1.49M per cow, one time cost	Rp1.49M per cow, one time cost	Rp2.59M per cow, one time cost
✓		✓
✓		✓
✓		✓
✓		✓
✓	✓	✓
	✓	✓
	✓	✓
	✓	✓
	✓	✓
	✓	✓
✓	✓	✓
✓	✓	✓
✓	✓	✓
		✓
		✓
✓	✓	✓
✓	✓	✓
✓	✓	✓

LET'S DO FIELD TRIAL

We understand that before the real large implementation, customers often need to try out the solution first.

Let's discuss.

Implementation Phases



Field Trial

Limited implementation to try out the solution, identify unique requirements, and key success indicators.

Device amount: 5 - 10 pcs

Duration: 1 - 3 months

Lessons-learned & Customization

Collect lessons-learned, key success indicators, feedbacks. Then decide the next steps.

Collect and new requirements, propose system design that accommodates customisation and improvement needed

Develop new system

Duration: 1 - 3 months

Real Implementation

Real and massive implementation

User assistance is provided

Device amount: upon request

Duration: 3 - 6 months

In the near future...

SMARTernak is not only for cows

It's about precision livestock farming platform



Ruminant Livestock

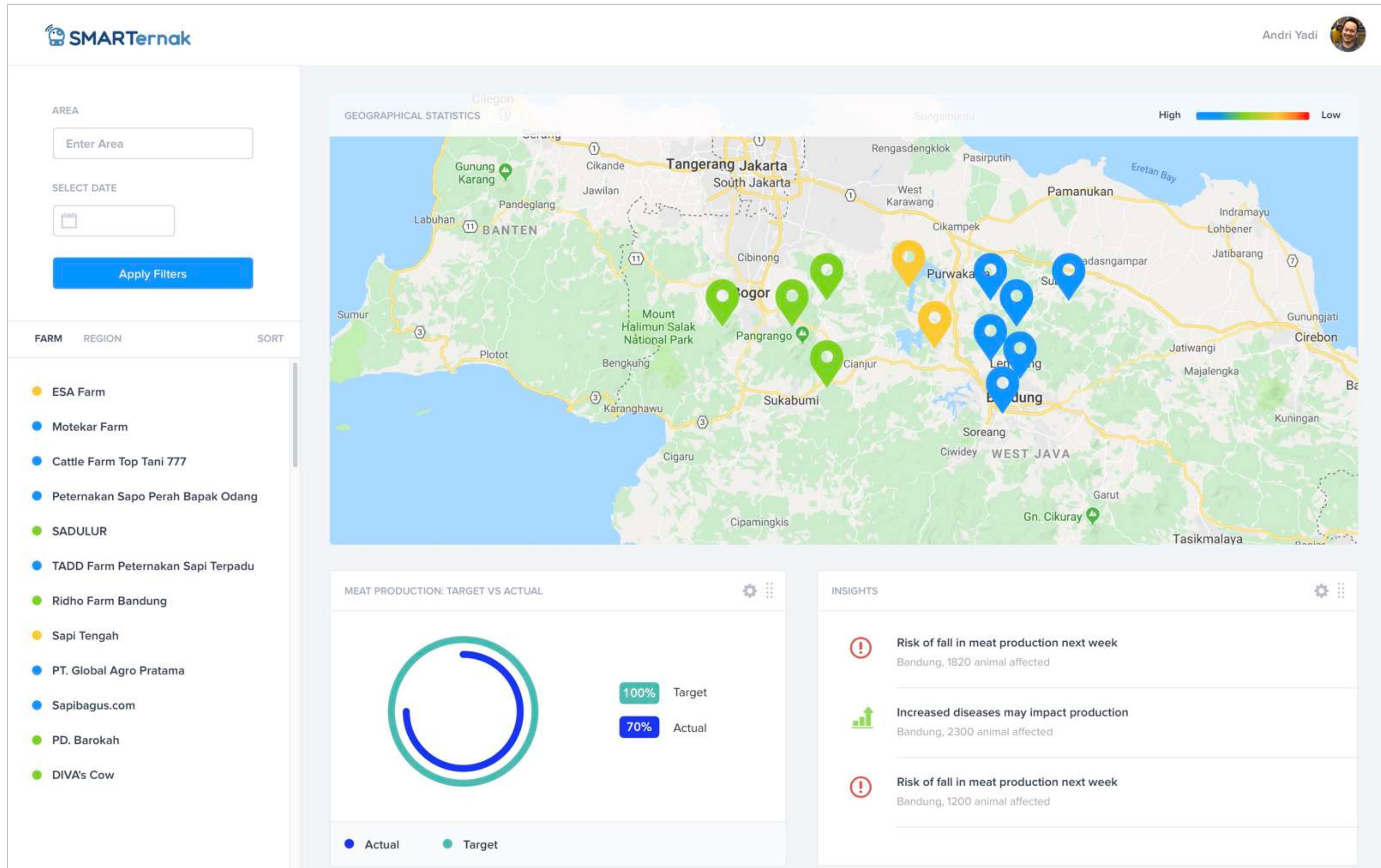


Wild Animal Tracking



Poultry

In the future...



DycodeX is much more than just
SMARTernak and Agricultural space

Other Real-World Products & Solutions



AI & IoT-powered devices & platforms



General-purpose Asset
Tracker Platform



Bike Fleet Management

Asset tracking



Livestock-farming
assistance platform

Agriculture



Personal tracker,
emergency assistance, ...

Security



Smart Trash Management



Electricity Power
Monitoring

Energy &
Environment



Industrial Environmental Sensing

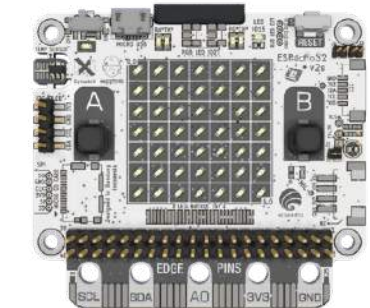


Pressure Transmitter
LPWA, 200 bar, liquid & gas



Machinery Health Sensor

Industrial IoT



IoT Prototyping Platform
for Education, Makers

Maker Movement

Custom IoT Hardware Design
Already helped 20 companies/
startups

End-to-end AI + IoT
Development
Firmware, cloud, AI, web & mobile

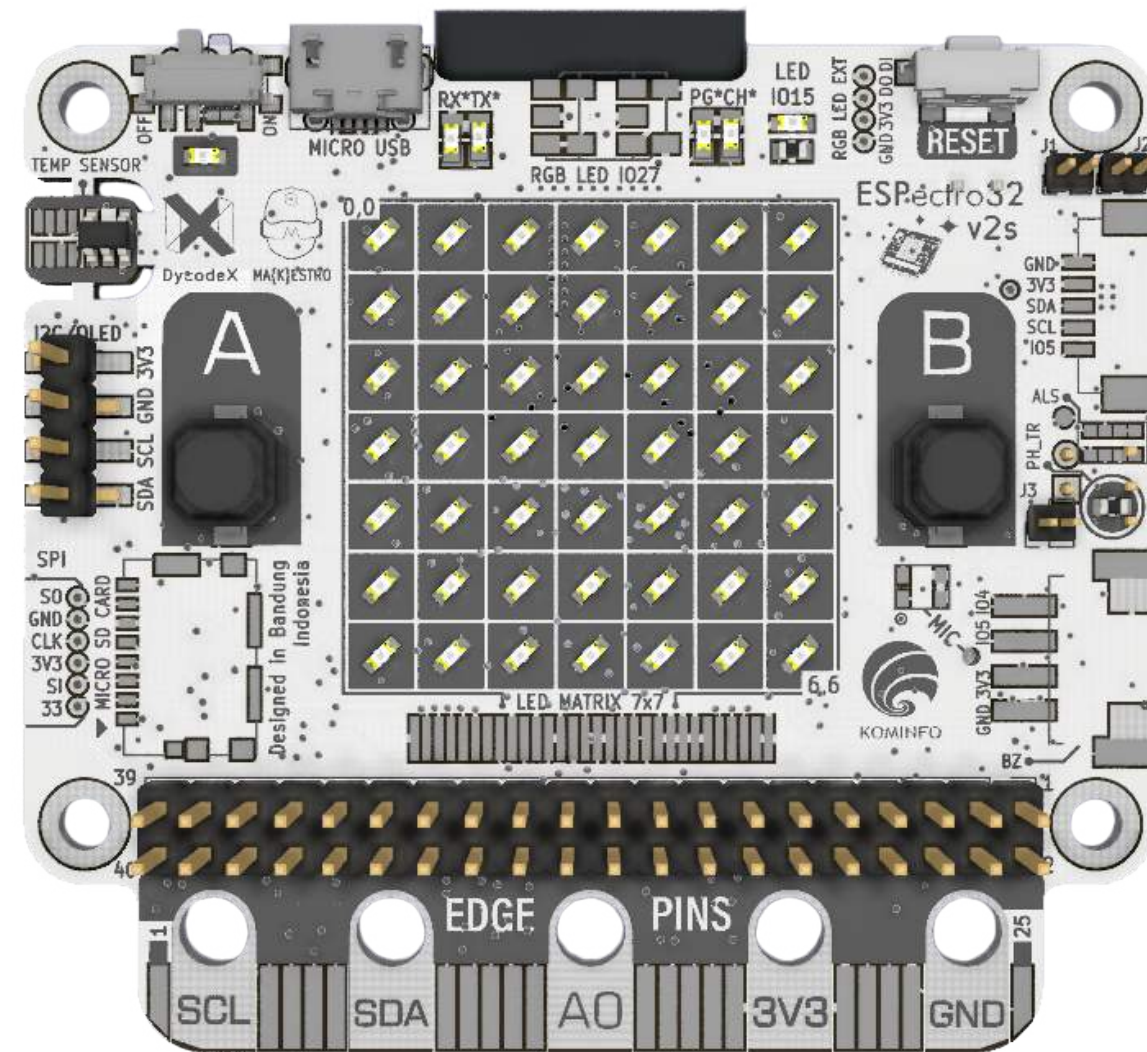
Design House

A product out to fight COVID-19

Codename: "HeatraX"

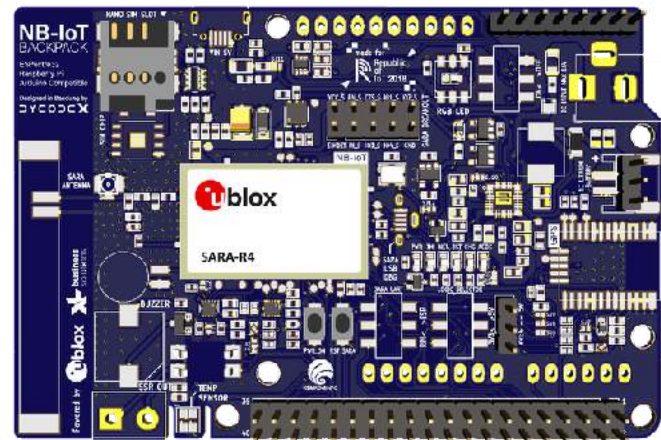


IoT Prototyping Platform for Education & Makers



ESpectro32

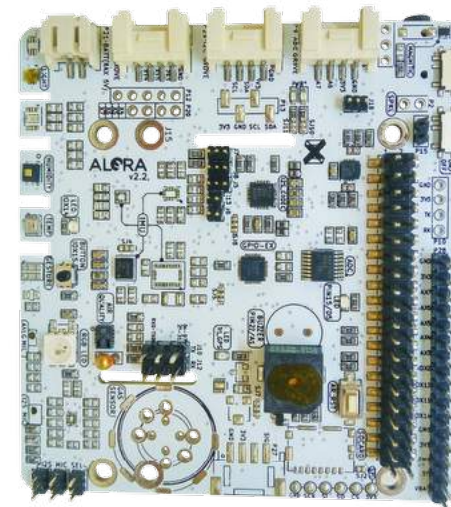
Backpacks



NB-IoT + GPS/GNSS Kit



LoRa/LoRaWAN +
GNSS Kit



Sensors & Actuators Kit
(20+ Peripherals)



3G + GNSS + Sensors

IoT Prototyping Platform

Optimized for learning STEM,
coding & electronics, also for fast
prototyping.

Already sold 1000+

Hardware:

ESpectro32: A development Board
having highly capable, low-power dual-
core Microcontroller, with built-in WiFi &
Bluetooth connectivity

Extensible with Backpacks: NB-IoT/
Cellular, LoRa, Sensor Kits, Motor Driver,
and more

Software:

Arduino Software-compatible, supported
by ready-to-use libraries

Learn to code with:

Visual drag-and-drop blocks*

Swift Playground*

IoT Cloud: to easily connect IoT devices

All products' electronic board is designed & assembled in-house by 100% Indonesian

* in development

Local & Global Partners

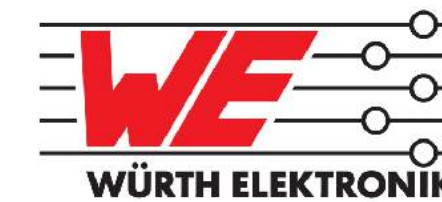
Supported by
3 Ministries of Republic of Indonesia



Local Partners:



Partnering with global brands for IoT R&D,
component supply, mass production, and go
to market



APAC Innovators



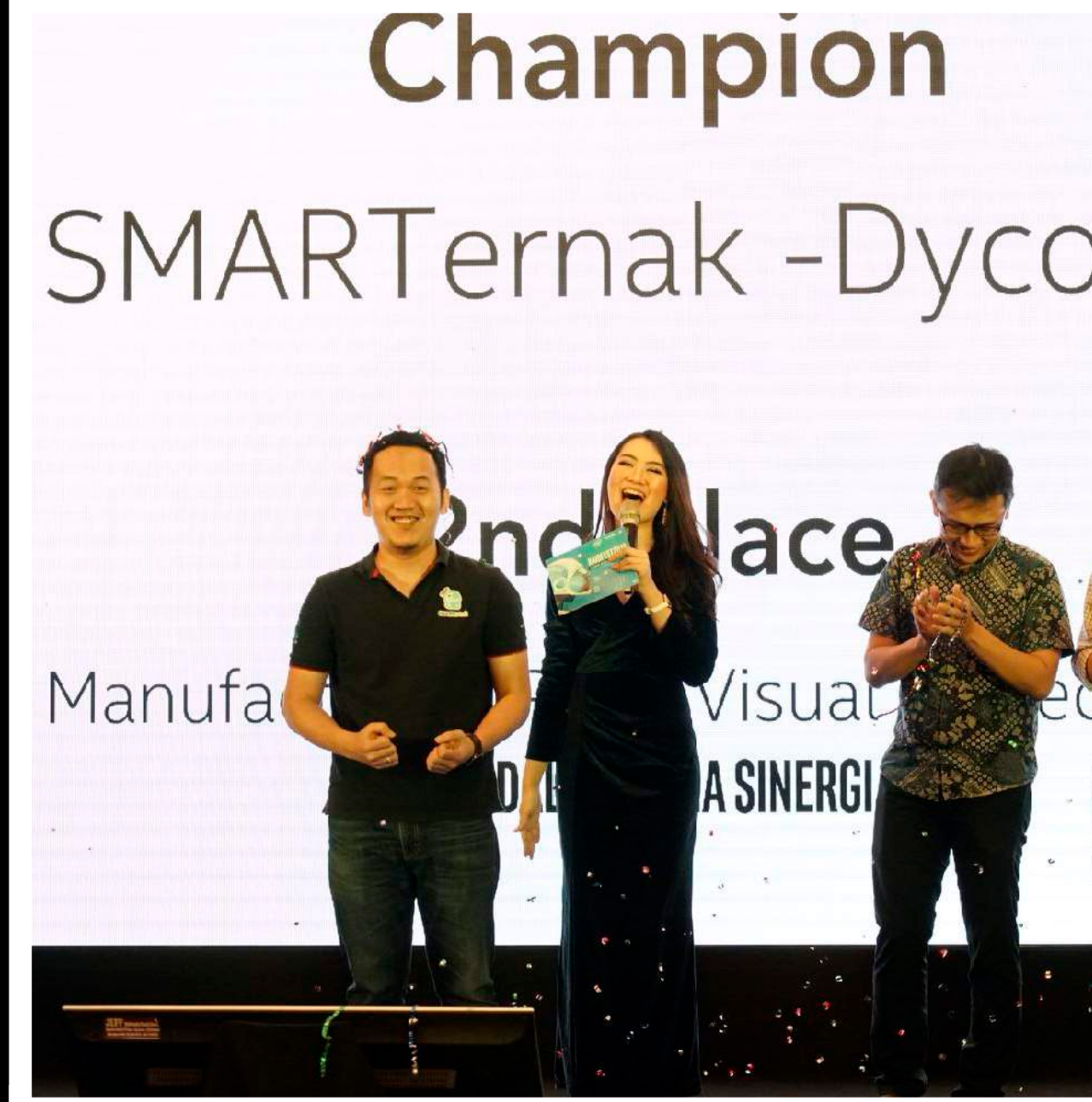
Some Awards & Recognitions



The local winner & represents Indonesia to the 1st Google Demo Day Asia



Won Rice Bowl Award 2018 for IoT Maker Ecosystem Initiator



Champion of the 1st Intel Indonesia OpenVino Challenge (AI competition)



Won Merit Award in Asia Pacific ICT Alliance (APICTA) 2019 Awards for IoT Category

More Awesome Journey: <https://dycodex.com/milestone/?data-value=192>

DEMO DAY

Google

SMARTernak terpilih sebagai satu-satunya produk dalam negeri yang mewakili Indonesia di ajang Google Demo Day Asia 2018

Perjalanan panjang Kami:
<https://dycodex.com/milestone/>



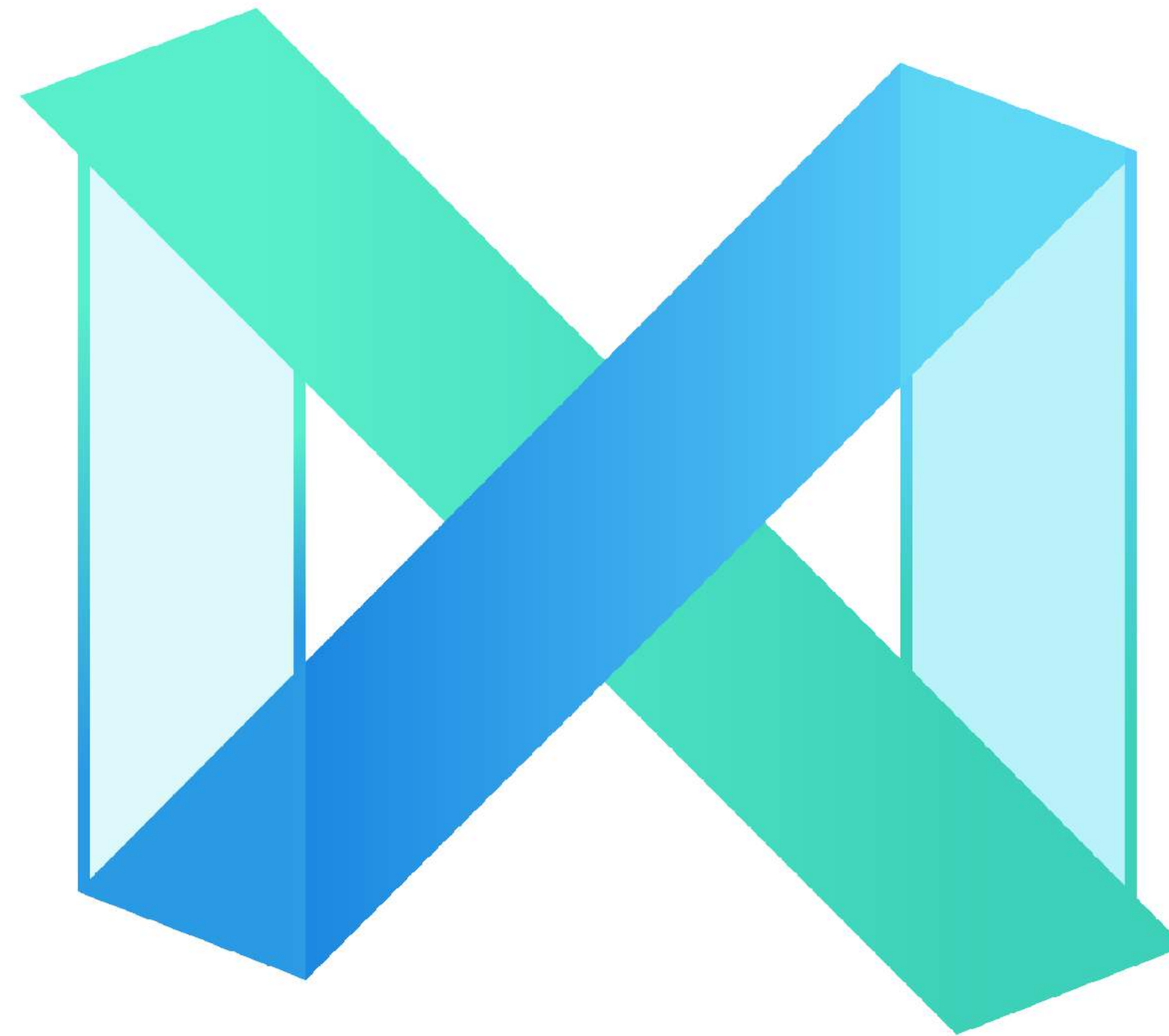
Desa Digital dengan SMARTernak

Sehatkan Sapi, Sejahterakan Negeri

hi@dycodex.com | <https://smarternak.com>



Keep in touch



DYCODEX
AI + IoT enabler

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